# DRAFT RECOVERY PLAN

**for**

# JOHNSON'S SEAGRASS

**(*Halophila johnsonii*)**

**prepared by the**

**Johnson's Seagrass Recovery Team**

**for the**

**National Marine Fisheries Service**
**National Oceanic and Atmospheric Administration**

**May 2000**

*Approved:* _____

*National Marine Fisheries Service*
*National Oceanic and Atmospheric Administration*

## Disclaimer

This recovery plan for *Halophila johnsonii* (Johnson's seagrass) has been approved by the National Marine Fisheries Service. It does not necessarily represent official positions or approvals of cooperating agencies nor the views of all individuals involved in the plan's formulation. The National Marine Fisheries Service has determined that the information used in the development of this document represents the best scientific and commercial data available at the time it was written. The Recovery Plan was prepared by the Johnson's Seagrass Recovery Team to delineate reasonable actions that will promote protection of Johnson's seagrass. This plan is subject to modification as dictated by new findings, changes in species status, and completion of tasks described in the plan. Goals and objectives will be attained and funds expended contingent upon agency appropriations and priorities.

Literature Citations should read as follows:

National Marine Fisheries Service. 2000. Recovery Plan for Johnson's Seagrass (*Halophila johnsonii*). Prepared by the Johnson's Seagrass Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. 99 pages.

## Preface

Congress passed the Endangered Species Act of 1973 (16 USC 1531 *et seq*, amended 1978, 1982, 1986, 1988) (ESA) to protect species of plants and animals endangered or threatened with extinction. The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) share responsibility for the administration of the ESA. The NMFS is responsible for most marine and anadromous species including Johnson's seagrass.

Section 4(f) of the ESA directs the responsible federal agency to develop and implement a recovery plan, unless such a plan would not promote the conservation of a species. The NMFS determined that a recovery plan would promote conservation and recovery of Johnson's seagrass. The Johnson's Seagrass Recovery Team included seagrass and management experts from the state and federal governments.

The NMFS agrees with the Johnson's Seagrass Recovery Team in that the goals and objectives of this recovery plan can be achieved only if a long-term commitment is made to support the actions recommended here. Achieving these goals and objectives will require the cooperation of state and federal government agencies.

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## List of Abbreviations

| | |
|---|---|
| ASMFC | Atlantic States Marine Fisheries Commission |
| CARL | Conservation and Recreation Lands |
| CCP | Coastal Construction Permit |
| COE | U.S. Army Corps of Engineers |
| DGPS | Digital Global Positioning System |
| EFH | Essential Fish Habitat |
| EPA | Environmental Protection Agency |
| ERP | Environmental Resource Permitting |
| ESA | Endangered Species Act |
| F.A.C. | Florida Administrative Code |
| FDACS | Florida Department of Agriculture and Consumer Services |
| FDEP | Florida Department of Environmental Protection |
| FFA | Florida Forever Act |
| FWC | Florida Fish and Wildlife Conservation Commission |
| FNAI | Florida Natural Areas Inventory |
| FR | Federal Register |
| F.S. | Florida Statutes |
| GIS | Geographic Information System |
| GPS | Global Positioning System |
| HCD | NMFS/ Habitat Conservation Division |
| IRL | Indian River Lagoon |
| IRLCCMP | IRL Comprehensive Conservation and Management Plan |
| IRLNEP | IRL National Estuary Program |
| JCP | Joint Coastal Permit |
| MSSW | Management and Storage of Surface Waters Program |
| NMFS | National Marine Fisheries Service |
| NOAA | National Oceanographic and Atmospheric Association |
| NOS | National Ocean Service |
| OFWs | Outstanding Florida Waterways |
| PAR | Photosynthetically Active Radiation |
| PLRGs | Pollution Load Reduction Goals |
| RAPD | Randomly Amplified Polymorphic DNA |
| SAFMC | South Atlantic Fisheries Management Council |
| SAV | Submerged Aquatic Vegetation |
| SJRWMD | St. Johns River Water Management District |
| SFWMD | South Florida Water Management District |
| SWIM | Surface Water Improvement and Management Act |
| WMDs | Water Management Districts |
| WR | Wetland Resource Permit Program |
| USCG | United States Coast Guard |
| USFWS | United States Fish and Wildlife Service |

## Executive Summary

**Current Species Status:** Johnson's Seagrass (*Halophila johnsonii*) was listed as threatened on September 14, 1998 (63 FR 49035): the first marine plant species to be listed under the ESA. Critical habitat for Johnson's seagrass was designated on April 5, 2000 (65 FR 17786). *Halophila johnsonii* has been found growing only along approximately 200 km of coastline in southeastern Florida between Sebastian Inlet and north Biscayne Bay. The species is rare, has a limited reproductive capacity, and is vulnerable to a number of anthropogenic and natural disturbances.

**Habitat Requirements and Limiting Factors**: Where present in its limited geographic range, *H. johnsonii* often grows in a patchy, non-contiguous distribution at water depths extending from the intertidal down to -3 meters (m). *Halophila johnsonii* appears to reproduce only through asexual branching. Principal threats to the species' survival include: 1) habitat destruction from dredging, shading from overwater structures, prop scarring, altered water quality, and siltation; 2) inadequacy of existing regulatory mechanisms to protect seagrasses; and 3) stochastic storm events.

**Recovery Goal:** To delist Johnson's Seagrass and to assure its persistence throughout its range.

**Recovery Objective and Criteria:** *Halophila johnsonii* should be considered for delisting when the following conditions are met: 1) The species' present geographic

range is stable or increasing; 2) Sufficient self-sustaining populations are present throughout the range to allow for stable vegetative recruitment; and 3) Populations and supporting habitat in its geographic range have long-term protection (through regulatory action or purchase acquisition).

**Actions Needed:**

1. Identify and protect populations and habitat.
2. Initiate a range-wide monitoring program.
3. Refine habitat requirements of *H. johnsonii.*
4. Conduct detailed life history studies of *H. johnsonii* to examine vegetative fragment dispersal, survival, and sexual reproduction.
5. Determine habitat management needs and techniques.
6. Identify the genetic diversity and genetic structure of *H. johnsonii* across its geographic range.
7. Develop restoration techniques.
8. Formulate an educational outreach program for *H. johnsonii* and seagrass habitat.

**Cost of Recovery Tasks:** The costs of recovery and protection are undeterminable at this time. Refer to the Implementation Schedule for cost estimates for individual tasks. Cost estimates were not available for some tasks because the actual procedures or actions for accomplishing these tasks are not yet known. In addition, many of the tasks are linked to one another so that accomplishing one may allow for others to be concurrently achieved. Therefore, accurate cost estimates were impossible to predict.

## INTRODUCTION

The seagrass *Halophila johnsonii* Eiseman (Johnson's seagrass) is a rare plant that may have the most limited distribution of any seagrass on earth. Within its distributional range, *H. johnsonii* is also the least abundant seagrass species (Virnstein et al. 1997). It frequently occurs in small (cm to a few m diameter) isolated patches. Unlike most *Halophilas*, which can survive perturbations by using sexual reproduction to disperse and maximize offspring, *H. johnsonii* appears to reproduce only through asexual branching or apomixis (Eiseman and McMillan 1980). There are no known seed banks, and although experiments have shown that vegetative fragments survive when transplanted into the field and in experimental mesocosms, there is only circumstantial evidence for unassisted recruitment by naturally produced fragments. Thus, the plant is less likely to be able to repopulate an area if lost due to human or environmental perturbations. The apparent lack of sexual reproduction suggests this species may have limited genetic diversity. Because of its small size and minimal stored reserves, local populations of *H. johnsonii* may decline during periods of unfavorable conditions, be out competed by larger seagrasses, or become overgrown by macroalgae. *Halophila johnsonii* is particularly vulnerable to sediment disturbances, trampling, and prop scarring due to its fragile nature and predominantly shallow growth habit and, for these reasons, it will have a limited recovery potential. Populations located near inlets are likely to experience erosional forces associated with severe storms and impacts due to concentrated boating activities.

## TAXONOMY

Presently, there are 12 recognized species of seagrass in the genus *Halophila* (den Hartog 1970). The genus is distributed in warm-temperate and tropical waters worldwide; the only pan-tropical species is *H. decipiens*. All species of *Halophila* are morphologically distinguished from the other seagrass genera by having either a pair of leaves or a pseudowhorl of leaves at each rhizome node. Most *Halophilas* are small, shallow rooted, and have 2-3 orders of magnitude less biomass per unit area compared to all other seagrass genera. Although small, biomass turnover rate is relatively high, and the plants decompose quickly (Kenworthy et al. 1989).

### Diagnostic Characteristics of *Halophila johnsonii*

After many years of confusion over identification, *H. johnsonii* (Johnson's seagrass) was formally proposed as a separate species by Eiseman and McMillan (1980). *Halophila johnsonii* was previously referred to either as *H. decipiens* or *H. baillonis* (which was later placed in synonymy with *H. decipiens*), but it most closely resembles *H. ovalis*, an Indo-Pacific species, both morphologically and genetically (McMillan and Williams 1980). Plant classification schemes based on anatomical (den Hartog 1970) and molecular phylogenetic (Les et al. 1997) methods both place the seagrass genus *Halophila* in the angiosperm family Hydrocharitaceae, along with two other seagrass genera, *Thalassia* and *Enhalus*. Morphologically, Johnson's seagrass is recognized by the presence of pairs of linearly shaped foliage leaves, each with a petiole formed on the node of a horizontally creeping rhizome (Figure 1). The rhizome is located at or just below the sediment surface and is anchored to unconsolidated substrate by unbranched

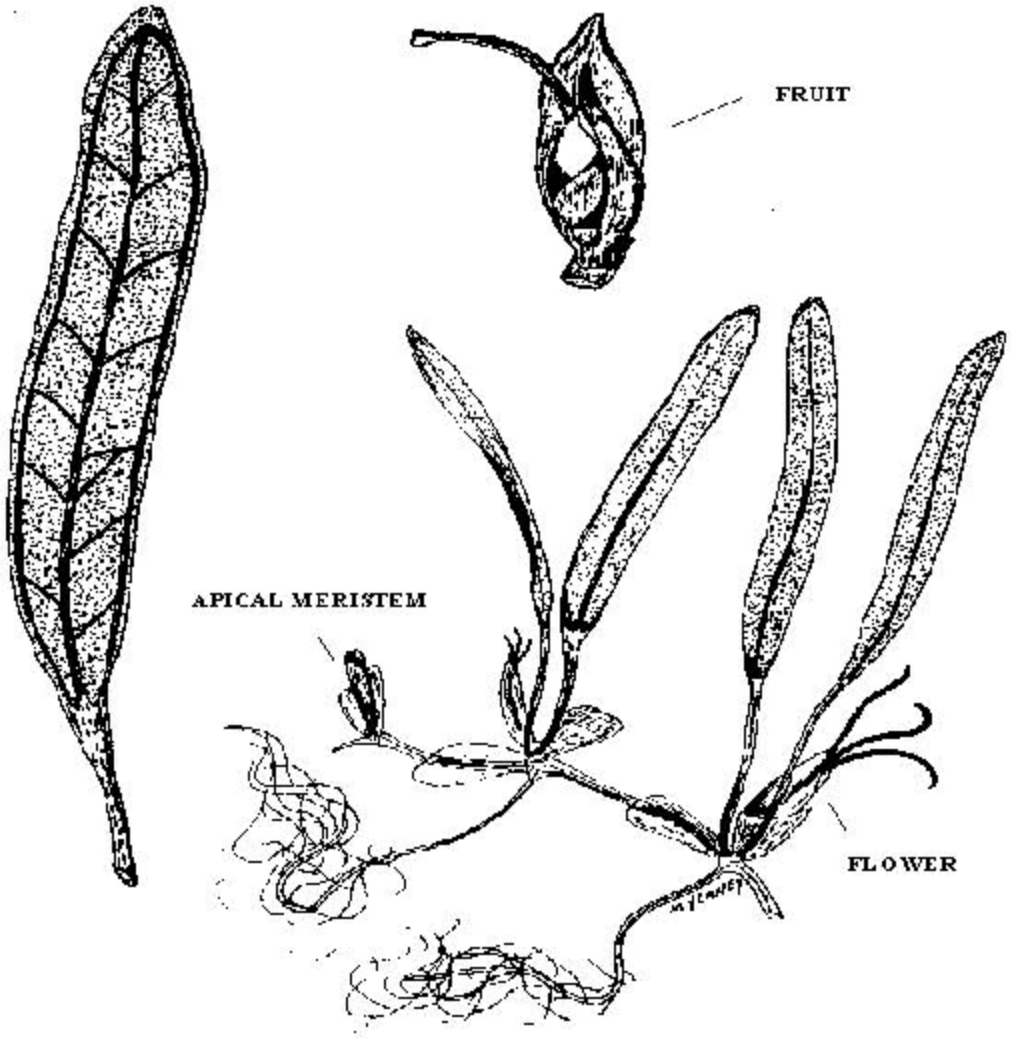



Figure 1. (see Table 1). *Halophila johnsonii*. Leaves are generally 2-5cm long. Adapted from Eiseman and McMillan, 1980.

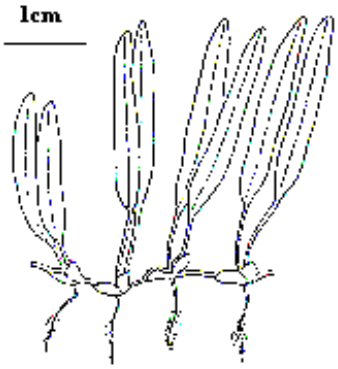
roots. The leaves are generally 2-5 cm long (including the petioles), and the rhizome internodes rarely exceed 3-5 cm in length, making this species appear diminutive relative to the larger seagrasses. *H. johnsonii* differs from *H. decipiens* in a number of morphological, reproductive, and genetic characteristics (Table 1). The diagnostic characteristics of *H. johnsonii* remain relatively unchanged when plants are cultured in artificial conditions; thus, differences between the two species are not due to phenoplasticity.

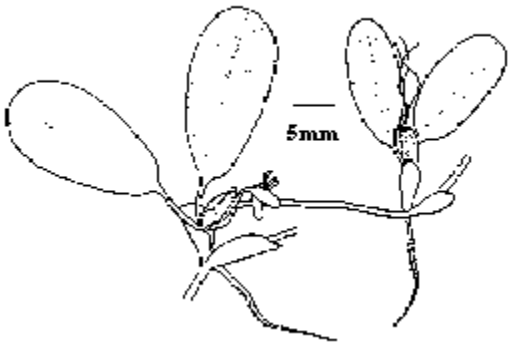
**POPULATION SIZE AND DISTRIBUTION**

Although the genus *Halophila* has one of the most extant distributions of all the seagrasses, *H. johnsonii* has only been found growing along approximately 200 km of coastline in southeastern Florida between Sebastian Inlet and north Biscayne Bay (Figure 2). This narrow range and apparent endemism indicates that *H. johnsonii* has the most limited known geographic distribution of any seagrass in the world. Species of *Halophila* are documented to occur from intertidal to 85 m depths (may be the deepest growing seagrasses); shallow occurrence is frequently associated with high turbidity. *Halophilas* regularly occur in 30-40 m depths, thus are important contributors to primary production of coastal shelf environments (e.g., extensive beds on the West Florida Shelf). Some species are the primary colonizers of disturbed environments, apparently due to their tolerance to low light, their high sexual fecundity, and their rapid horizontal growth rates. Unassisted recruitment by vegetative fragments has never been documented for any *Halophila* species (Heidelbaugh et al. 1999).

Table 1. Morphological, reproductive, and genetic characteristics of *H. johnsonii* and *H. decipiens*.

| ***H. johnsonii*** | ***H. decipiens*** |
|---|---|
| Linear leaves with entire (smooth) margins. | Oblong-elliptical leaves with serrate margins. |
| No hairs on blade surface. | Unicellular prickle hairs on both surfaces (unique to *H. decipiens*). |
| Leaf cross veins diverge at ca. 45° angles. | Leaf cross veins at ca. 60° angles. |
| Only pistillate (female) flowers are known so it is possibly dioecious (male and female plants) or apomictic (produces seeds without pollination or meiosis so seeds are clones of female parent). | Monoecious (both sexes on one plant). |
| Populations of *H. johnsonii* collected in the Indian River Lagoon (IRL) differed from *H. decipiens* in five isozymes of the seven isozyme systems tested, with major differences in three of the enzymes (Jewett-Smith et al., 1997). | See Previous box |




*H. johnsonii* *H. decipiens*

Adapted from Phillips and Menez,1988.

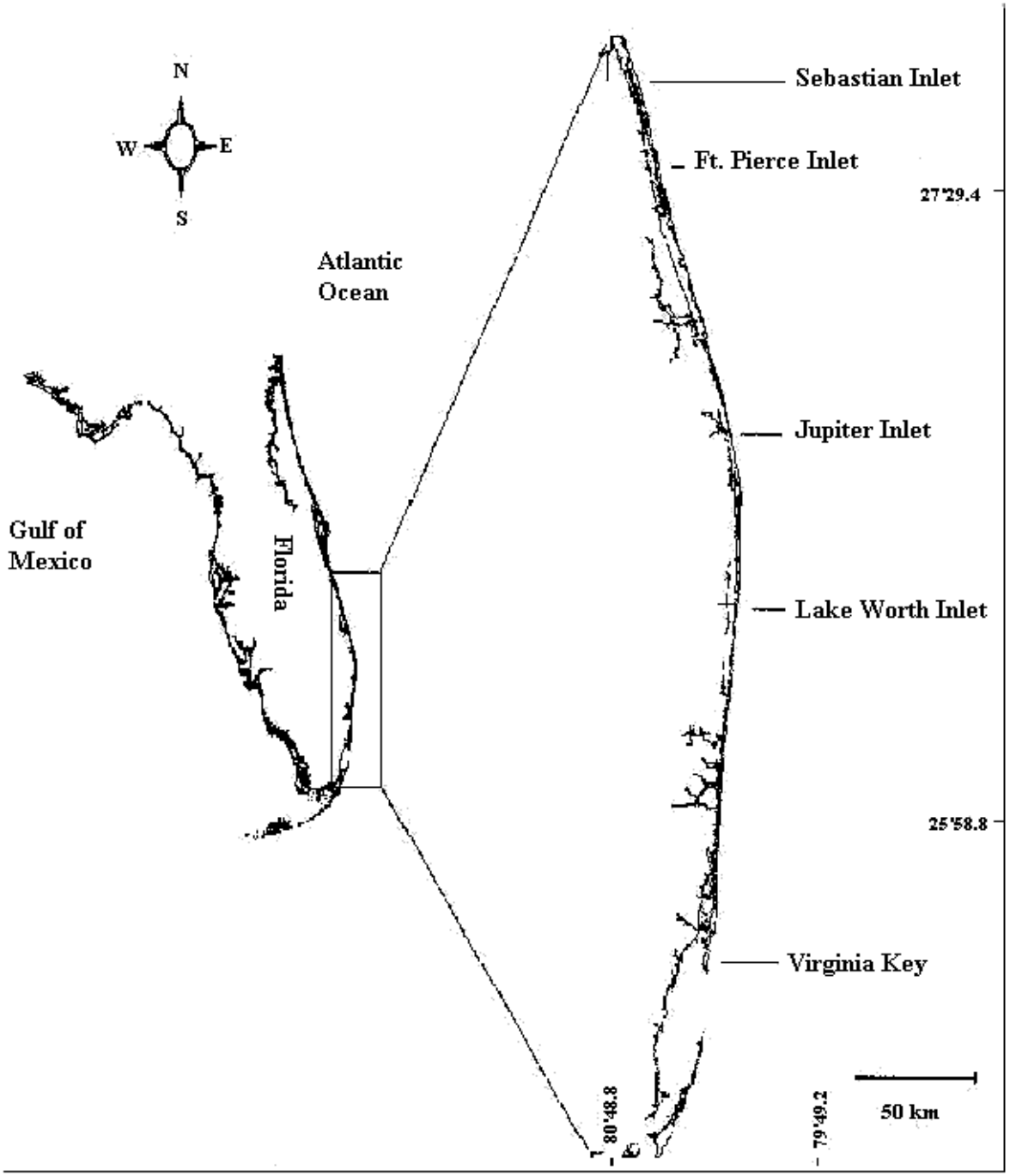



Figure 2. Geographic range of *Halophila johnsonii*: Sebastian Inlet to northern Virginia Key.

Where present, *H. johnsonii* often grows in a patchy, non-contiguous distribution at water depths extending from the intertidal down to -3 m (Kenworthy 1993; Virnstein et al. 1997). Intertidal populations may be completely exposed at low tides, suggesting tolerance to dessication and wide temperature ranges. The largest known contiguous distribution of patches occurs near the northern (Sebastian Inlet) and central range of this species (Lake Worth). Although it is more commonly found in monotypic patches, Johnson's seagrass can also occur among low to moderate densities of *Halodule wrightii* and *Syringodium filiforme*, and mixed with *H. decipiens* in deeper water.

Observations of its distribution and the results of some very limited experimental work suggest that *H. johnsonii* has a wider tolerance of salinity, temperature, and optical water quality conditions than *H. decipiens* (Dawes et al. 1989). Documented salinity range is 15-43 parts per thousand (ppt) (physiological salinity tolerance range may be greater) (Dawes 1989; Virnstein et al. 1997) and the species has been observed growing perennially near the mouths of freshwater discharge canals (Gallegos and Kenworthy 1996). Johnson's seagrass does not exhibit photoinhibition at high light intensities as does *H. decipiens*, so it is found growing from deeper turbid waters of the interior portion of the IRL up to the intertidal. Johnson's seagrass also grows in clear water associated with the high energy environments and flood deltas inside ocean inlets where tidal velocities approach the threshold of motion for unconsolidated sediments (35-40 cm $sec^{-1}$).

## GROWTH FORM AND REPRODUCTIVE BIOLOGY

Johnson's seagrass grows vegetatively by the division of meristems located on the apex of the horizontal rhizome and in the axial point (node) where the petioles intersect the rhizome. As in all clonal plants, vegetative growth and areal coverage is achieved by meristem division, the iteration of modules (leaf pairs and apical meristems), and branching of the horizontal stem (rhizome). Since seagrasses are angiosperms, many species also reproduce sexually; however, no male flowers have ever been described nor is there any evidence of successful recruitment by seed for Johnson's seagrass, even with extensive, decade-long observations. Female flowers of *H. johnsonii* arising from the base of the petioles are enclosed in a two-leaved spathe. The fruits are long-necked with 3 stigmas, each 2-4 cm in length.

Wide tolerance to salinity, temperature and light, a broader depth distribution, and possible sterility are evidence of hybridization. However, there is no evidence of sexual reproduction. The absence or rarity of sexual reproduction means populations of *H. johnsonii* must rely on asexual branching for maintenance and dispersal. Thus, *H. johnsonii* will be at a disadvantage compared to either the highly fecund *H. decipiens* or the larger seagrasses in re-establishing after periods of unfavorable conditions. The competitive advantage of the larger seagrasses stems from their size and the energy storage capabilities of their comparatively larger rhizomes, which provide a buffer during unsuitable conditions. Small species can survive these unfavorable environmental conditions by the production of a seed bank which allows the plants to re-emerge when favorable conditions return, but seed viability is unknown for *H. johnsonii*.

## ECOLOGICAL ROLE OF *HALOPHILA JOHNSONII*

Despite its diminutive size, studies indicate that Johnson's seagrass provides all the well-known benefits larger seagrasses provide (i.e., a food source, a refuge, and nursery for numerous wildlife species, sediment stabilization, and deceleration of water currents and waves reducing turbidity and erosion (Zieman 1982; Fonseca 1994; Phillips and Menez 1988). Patches of *H. johnsonii* offer a level of support for epiphytes and epifauna (Hodgsin 1981; Virnstein et al. 1983; Howard 1987; Virnstein and Howard 1987) and algae (Thompson 1978; Virnstein et al. 1985; Hall and Bell 1988; Holmquist 1994). Like other *Halophila* species, because of its small size and rapid turnover rate, this seagrass is especially important in detritus and nutrient cycling (Kenworthy 1993). Green sea turtles, West Indian manatees, and dugongs are known to feed on *Halophila* species (Bjorndal 1981; Packard 1981; Lefebvre 1991; Foley and Bolen 1996; Jupp et al. 1996).

Rapid growth can allow *H. johnsonii* to play a role as colonizer and stabilizer after a disturbance and before the larger seagrasses can establish themselves (Packard 1981; Fonseca 1989; Kenworthy 2000). *Halophila johnsonii* increases the threshold velocity for sediment motion as has been reported for the similar-sized *H. decipiens* (Fonseca 1989).

## CURRENT STATUS AND HISTORICAL CONDITIONS

No monitoring program exists specifically for *H. johnsonii.* The most comprehensive and quantitative distribution and abundance data comes from the State of Florida Surface

Water Improvement and Management Act of 1987 (SWIM) Project. Since 1994, all seagrass species have been monitored twice a year within 1-$m^2$ quadrats placed every 10 m along 75 fixed transects between Sebastian Inlet and Jupiter Inlet. The following information is based on this seagrass monitoring program.

*Halophila johnsonii* is discontinuous within its overall geographic range in the IRL (from Sebastian Inlet to Jupiter Inlet). It occurs opportunistically over a wide range of depths (intertidal to 180 cm), salinities, and water quality. *Halophila johnsonii* was found at 20 of 33 transects within its range during 1994-1997, but at not more than 12 transects at any one sampling time. Eight of the transects were specifically located to include *H. johnsonii*; the species is therefore over-represented compared to random sampling. Where it does occur, its distribution is patchy, both spatially and temporally. It occurred in 4.6% (106 of 2,280) of the 1-$m^2$ quadrats sampled within its range. Average percent cover (measured as shoot frequency within grid cells of the quadrat) over all sampling dates and transects within its range was 1.5%.

It is a perennial plant with no strong seasonal pattern in all years, although it generally exhibits some winter decline. There is no apparent pattern of increase or decrease in abundance or geographic range over the period of study (through 1999). The recent increase in search effort (as this plant becomes more widely recognized) may be responsible for any apparent increase in recently reported occurrences.

**REASONS FOR LISTING**

After a thorough review and consideration of all information available, NMFS concluded that *H. johnsonii* warrants listing as a threatened species. Procedures found at section 4(a)(1) of the ESA (16 U.S.C. 1531 et seq.) and regulations (50 CFR part 424) promulgated to implement the listing provisions of the ESA were followed. A species may be determined to be endangered or threatened due to one or more of the five factors described in section 4(a)(1). These factors and their application to *H. johnsonii* are as follows:

*1. Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range.*

Habitat within the limited range in which *H. johnsonii* exists is at risk of degradation or destruction by a number of human and natural perturbations, including (1) dredging, (2) prop scarring, (3) storms, (4) altered water quality, and (5) siltation. Due to the fragile nature of *H. johnsonii*'s shallow root system, the plants are vulnerable to human-induced disturbances in addition to the major natural disturbances to the sediment, and their potential for recovery may be limited. Destruction of benthic communities due to boating activities (propeller scarring and anchor mooring) was observed at all *H. johnsonii* sites during the NMFS study. Further, this condition is expected to worsen with the predicted increase in boating activity. This severely disrupts the benthic habitat by severing rhizomes and significantly reducing the viability of the populations. Trampling due to human disturbance and increased land-use induced siltation can also threaten the viability of the species.

Turbidity is a critical factor in the distribution and survival of seagrasses, especially in deeper regions of the lagoon, where reduced Photosynthetically Active Radiation (PAR) limits photosynthesis. Shallow regions are less affected by turbidity unless light is rapidly attenuated. In interior lagoonal areas where salinity is low, highly colored water typically is discharged via drainage systems. Stained waters attenuate shorter wavelengths rapidly, removing important PAR as well as potentially stressing plants by lowering salinity. This is a critical factor in the vicinity of Sebastian, St. Lucie, Jupiter, and Ft. Pierce Inlets, and Lake Worth and North Biscayne Bay, where freshwater reaches the flood tide deltas and nearby seagrass meadows via rivers and canal systems discharging into the lagoon. Under certain conditions, these effects may also be severe at lagoonal sites farther from the inlets.

Degradation of water quality due to human impact threatens the welfare of all seagrass communities, including those of *H. johnsonii*, and subsequently affects fishery resource productivity, in general. Nutrient over-enrichment caused by inorganic and organic nitrogen and phosphorous loading via urban and agricultural land run-off can stimulate increased algal growth that may smother the understory of seagrasses, particularly *H. johnsonii*, shade rooted vegetation, and diminish the oxygen content of the water. Such low oxygen conditions have a demonstrated severe negative impact on seagrasses and associated communities.

*2. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes.*

Overutilization for these purposes has not been a documented factor in the decline of this species.

*3. Disease or Herbivory*

There are two known large herbivores that occur in the range of *H. johnsonii*—the green sea turtle (*Chelonia mydas*), and the West Indian manatee (*Trichechus manatus*), both of which feed upon the seagrass. Herbivorous fish also feed upon the seagrass communities, but herbivory pressure alone is not likely to be a threat to the species' existence.

*4. Other Natural or Human-made Factors Affecting the Species' Continued Existence.*

The existence of the species in a very limited range increases the potential for extinction from stochastic events. Natural disasters such as hurricanes could easily diminish entire populations and a significant percentage of the species. Seagrass beds that are in proximity to inlets are especially vulnerable to storm surge from hurricanes and severe storm events.

*5. The Inadequacy of Existing Regulatory Mechanisms.*

Despite existing federal and Florida state laws aimed to conserve and protect seagrass habitat, there is a continued and well-documented loss of seagrass habitat in the United States and Florida. For example, seagrasses have declined in many areas of the IRL

(Virnstein and Morris 1996). Seagrass loss and environmental degradation of submerged lands continue relative to the existing federal and state regulatory programs. Examples of such programs include FDEP and COE dock construction, ERP permitting, and EPA/FDEP water quality standards (light attenuation through turbidity set for phytoplankton).

A 1992 merge of the Florida Department of Natural Resources and the FDEP was not accompanied by an associated increase in staff for Marine Patrol, and the steady increase over the years in the Florida population, has greatly increased the new agency's assignment of enforcement responsibilities. It is unclear, at this point, how the recent 1999 merge of the FDEP Marine Resources Division into the FWC will affect the enforcement responsibilities of the Marine Patrol, including those responsibilities for enforcing environmental and boating regulations.

Although stormwater management systems have been or are being installed, the Florida IRL Act of 1990 covers only waste water treatment plants and does not cover other large inputs that will affect water quality, which in turn could affect seagrasses (e.g., industrial discharges, brine disposal, canals, processing plants).

Many seagrass ecosystems are known to recover very slowly even under the most natural, pristine conditions. Previous transplantation efforts to mitigate for the loss of seagrass beds have failed (Fonseca et al. 1998). Until recently, *Halophila* species have not been transplanted successfully in the field and studies underway are incomplete

(Heidelbaugh et al. 1999). Current efforts are insufficient to protect critical seagrasses. This was also the conclusion and recommendation of scientists attending the International Seagrass Workshop in Kominato, Japan in August 1993. Kenworthy and Haunert (1991) concluded that State of Florida's light and turbidity standards were inadequate to protect seagrasses.

**LISTING DETERMINATION**

Based on available information, NMFS concluded that Johnson's seagrass warrants listing as a threatened species. This species is rare, has a limited reproductive capacity, and is vulnerable to a number of anthropogenic and natural disturbances. Also, it exhibits the most limited geographic distributions of any seagrass. Within its small geographic range (lagoons on the east coast of Florida from Sebastian Inlet to central Biscayne Bay), it is one of the least abundant species. Because of its limited reproductive capacity and energy storage capacity, it is less likely to survive environmental perturbations and to be able to repopulate an area when lost. Finally, environmental degradation and habitat loss have continued despite existing federal and state conservation efforts.

*H. johnsonii* was listed as threatened on September 14, 1998 (63 FR 49035)(Appendix I). Critical habitat for Johnson's seagrass was designated on April 5, 2000 (65 FR 17786) (Appendix II).

## CONSERVATION MEASURES

### Federal Conservation Measures

NATIONAL MARINE FISHERIES (NMFS)

Johnson's seagrass is directly protected by provisions of the ESA under NMFS jurisdiction. Federal agencies conducting, permitting, or funding actions that may affect Johnson's seagrass are required to consult with NMFS Protected Resources Division.

Federal agency actions or programs that may affect Johnson's seagrass include: COE authorization of projects affecting waters of the United States under section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act (i.e., beach renourishment, dredging, and related activities including the construction of docks and marinas); Environmental Protection Agency (EPA) authorization of pollutant discharges and management of freshwater discharges into waterways; U.S. Coast Coast Guard (USCG) regulation of vessel traffic; management of national refuges and protected species by USFWS; management of vessel traffic and other activities by the U.S. Navy; authorization of state coastal zone management plans by NOAA/NOS; and management of commercial fishing and protected species by NMFS (NMFS 1998, page 49041).

The NMFS Habitat Conservation Division (HCD) acts in an advisory capacity in the protection of natural resources under NMFS purview and coordinates with the COE and other federal agencies on any federal projects which may affect these resources. Federal agencies, including NMFS/HCD, support the Living Marine Resource mandates, Submerged Aquatic Vegetation (SAV) policy (adopted May 1997), and Essential Fish

Habitat (EFH) amendments of the South Atlantic Fishery Management Council (SAFMC) and the Atlantic States Marine Fisheries Commission (ASMFC).

SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL (SAFMC)

The Council plays an advisory role in the protection of habitat essential to managed species as directed by the Magnuson-Stevens Fishery Conservation and Management Act. The Council and NMFS have coordinated their efforts to address their respective mandates in the Act. The Council actively comments and makes recommendations to federal and state agencies that may affect EFH, including SAV. Under the new EFH mandates of 1997, the Council began identifying and describing EFHs and amending existing fishery management plans to include these EFHs. The Council has also established a Habitat Advisory Panel and initiated workshops on habitat types, including seagrass habitats.

ATLANTIC STATES MARINE FISHERIES COMMISSION (ASMFC)

Based upon the importance and need to protect SAV habitats for ASMFC managed species, the ASMFC has developed policies in SAV and Habitat Conservation (ASFMC 1997). These policies have been incorporated into fishery management plans through amendments that describe EFHs for ASFMC trust resources and emphasize the need to protect and conserve SAV systems. The ASMFC encourages NMFS and USFWS to adopt and implement the plans, policies, and amendments. Depending upon the level of implementation, Johnson's seagrass and its habitat may be indirectly protected by these policies.

NATIONAL ESTUARY PROGRAM - INDIAN RIVER LAGOON NATIONAL ESTUARY PROGRAM (IRLNEP)

The Federal Water Quality Act of 1987 recognized the poor health of the nation's estuaries and need for their protection, and stated a national interest in maintaining the ecological integrity of the nation's estuaries. Section 320 of the Water Quality Act initiated the National Estuary Program.

The Indian River Lagoon Comprehensive Conservation and Management Plan (IRLCCMP) was published by the IRLNEP in November 1996 and is sponsored by the SJRWMD and the SFWMD in cooperation with the EPA. Priority problems identified in the IRLCCMP include loss of seagrass beds and increasing stress on remaining beds, undesirable salinity fluctuations, and increased nutrient loading. Action plans of the IRLCCMP include water and sediment quality improvement, seagrass restoration and management, and endangered and threatened species. The elements and action plans of the IRLCCMP are mutually supportive and complimentary to the management efforts of the State of Florida SWIM program.

U.S. FISH AND WILDLIFE SERVICE (USFWS)

Seagrass habitat, including Johnson's seagrass, is directly protected under the ESA by the USFWS as a critical habitat for the endangered Florida manatee. Protective mechanisms include section 7 consultations for dredging or water-dependent construction (including the building of docks and marinas), motorboat access and speed limits in seagrass beds to

reduce prop scarring, a long-term habitat monitoring program, and the designation of manatee sanctuaries and refuges (U.S. Fish and Wildlife Service 1995).

**State of Florida Conservation Measures**

ENVIRONMENTAL RESOURCE PERMIT PROGRAM

The Environmental Resource Permit Program (ERP) regulates dredging, filling, and other construction activities in wetlands or other surface waters, activities in uplands that affect flooding, and all stormwater management activities throughout the state (except within the limits of the Northwest Florida Water Management District). The ERP program is designed to ensure that alterations of uplands, wetlands, or surface waters do not degrade water quality, cause flooding, or diminish habitat quality or quantity. ERP was adopted in 1994 under Part IV, Chapter 373 of the Florida Statutes (F.S.), and is implemented cooperatively by the FDEP and the state's water management districts (WMDs). The SJRWMD and SFWMD cooperate with the Central and Southeast FDEP District offices in the region where *H. johnsonii* occurs. To allow an applicant to deal with only one agency when seeking an ERP permit, the review and approval or denial of the permit is performed by either FDEP or one of the WMDs, depending upon the type of activity involved. Operating agreements signed by the agencies specify the division of permitting responsibilities between the agencies. Rules implementing the ERP program have been adopted by both FDEP (including Chapters 62-4, 62-113, 62-302, 62-312, 62-330, 62-340, 62-341, 62-342, 62-343, 62-344, 62-B-49, 18-14, 18-20, 18-21 of the Florida Administrative Code (F.A.C.)) and the WMDs (including Chapters 40C-1, 0C-4, 40C-8,

40C-40, 40C-41, and 40C-400, F.A.C for the SJRWMD, and Chapters 40E-1, 40E-4, 40E-40, 40E-41, F.A.C. for the SFWMD).

The ERP program replaced two separate permitting programs, the Wetland Resource Permit program (WR) and the Management and Storage of Surface Waters program (MSSW). The WR program controlled dredge and fill activities, and was implemented exclusively by the Department of Environmental Regulation (now FDEP), while the MSSW program managed activities affecting stormwater and flooding, and was implemented exclusively by the five WMDs. Legislation establishing the ERP program included several grandfathering provisions that retain the above WR and MSSW permitting programs for certain activities listed in subsections 373.414(11)-(16), F.S. For these grandfathered activities, Chapter 62-312 F.A.C. and the MSSW permitting rules adopted under Part IV, Chapter 373, F.S. remain in effect as they existed prior to October 3, 1993. FDEP and the WMDs implement the programs covering these grandfathered activities in accordance with the same division of permitting responsibilities that governs the ERP program.

*Proprietary Authorization to Conduct Activities on Sovereign Submerged Lands*

In addition to regulatory permission, activities on sovereign (state-owned) submerged lands also require what is termed "proprietary authorization." Statutory authority for proprietary authorization is provided by Chapter 253, F.S., and the rules implementing this statute are in Chapter 18-21, F.A.C.. Requests for proprietary authorization are reviewed in conjunction with the regulatory application and are granted or denied at the

same time. More stringent resource protection measures are afforded for the state's Aquatic Preserves designated under Chapter 258, F.S. Additional requirements for Aquatic Preserves include: more restrictive water quality requirements (62-4.244(2), F.A.C.) and adequate demonstration that the activity is clearly within the public interest based on the public interest criteria listed in Chapter 373.414(1)(a), F.S. The majority of *H. johnsonii* habitat is already located within existing Aquatic Preserves and Outstanding Florida Waters (OFWs) (See Aquatic Preserves and OFWs Sections).

*Joint Coastal Permits*

Chapter 161, F.S. provided the FDEP Bureau of Beaches and Coastal Systems with the authority to regulate coastal construction activities via a Coastal Construction Permit (CCP). However, a Joint Coastal Permit (JCP) is issued when both a CCP (pursuant to Section 161.041, F.S.), and an ERP permit (pursuant to Part IV, Chapter 373, F.S), are required. Chapter 62B-49, F.A.C. outlines the procedures and requirements that must be met to obtain a JCP. Requests for proprietary authorization are reviewed in conjunction with the JCP application and are granted or denied at the same time.

The COE and FDEP/WMDs have joint WR and ERP permit application forms. FDEP or one of the WMDs acts as the lead agency to receive all applications for state and federal wetland permits and forwards copies of such applications to the COE within five working days. Issuance of the state permit constitutes federal section 401 water quality certification, unless such certification is specifically waived in the permit. However, the actual state and federal permitting processes remain separate, and applicants are required

to obtain all required federal, state, regional, and local permits prior to initiating construction activities.

*Delegation of ERP to Local Governments*

To further streamline the permitting process, Section 373.441, F.S. provides authority for FDEP and the WMDs to delegate all or a portion of ERP to local governments. If granted delegation, all necessary authorizations under the ERP program as well as any needed additional local permits will be granted or denied at the same time by the local government. To implement this statutory authority, FDEP has adopted a rule (Chapter 62-344, F.A.C.) to guide local governments in the application process and to outline criteria that will be used to approve or deny a delegation request. At present there has been no full delegation of ERP to any local government, although partial delegations have been given to Dade and Pinellas counties. Applications for full delegation are pending for the City of Tallahassee and Dade County.

FDEP AQUATIC PRESERVES PROGRAM

The FDEP Aquatic Preserves program (adopted under Chapter 258, F.S.) provides additional water quality protection to sovereign submerged lands with exceptional biological, aesthetic, or scientific value. Five of the state's 43 aquatic preserves (i.e., Indian River–Malabar to Vero Beach, Indian River–Vero Beach to Ft. Pierce, Jensen Beach to Jupiter Inlet, Loxahatchee River–Lake Worth Creek, and Biscayne Bay–Cape Florida) are located within the region where *H. johnsonii* occurs. Rules implementing the Aquatic Preserves program are Chapter 18-18, F.A.C., which is specific to the

Biscayne Bay Aquatic Preserve, and Chapter 18-20, F.A.C. which covers all other aquatic preserves. Special management plans have been developed for all aquatic preserves.

Aquatic Preserves within the range of *H. johnsonii*:

- Indian River Lagoon, Malabar to Sebastian (Brevard/Indian River)
- Indian River Lagoon, Vero Beach to Ft. Pierce (Indian River/St. Lucie)
- Indian River Lagoon, Jensen Beach to Jupiter Inlet (St. Lucie/Martin/Palm Beach)
- Loxahatchee River to Lake Worth Creek (Martin/Palm Beach)
- Biscayne Bay (Dade)

OUTSTANDING FLORIDA WATERS (OFW)

More than 200 waters throughout the state have been designated as OFWs, where more stringent water quality and permitting standards apply. These include the aquatic preserves previously discussed, as well as waters within national and state parks. Chapter 62-302 lists those waters designated as OFWs, and also lists the five classes of waters (each with specific water quality standards) within the state. In addition to the aquatic preserves previously listed, the major OFWs in the range of Johnson's seagrass include: Archie Carr, Hobe Sound and Loxahatchee National Wildlife Refuges; Savannas State Reserve; John D. MacArthur State Park; and Sebastian Inlet, Ft. Pierce Inlet, Hugh Taylor Birch, John U. Lloyd Beach, and Oleta River State Recreation Areas (F.A.C. 620-302.700).

## FDEP BUREAU OF INVASIVE PLANT MANAGEMENT

The FDEP Bureau of Invasive Plant Management regulates the importation, possession, collection, planting, relocation, or treatment of aquatic plants pursuant to Chapter 369, F.S. (implemented by Chapters 62C-20, 62C-52 and 62C-54, F.A.C.). The Bureau is charged with protecting sovereign lands from improper and excessive collection of native aquatic plants for purposes of sale, revegetation, restoration, or mitigation.

## FDEP ECOSYSTEM MANAGEMENT INITIATIVE

FDEP began the Ecosystem Management Initiative in 1993. Ecosystem management provides for new, voluntary, parallel permitting, and approval processes that give regulatory incentives to applicants. These optional processes require that projects be designed to provide some net environmental benefit. All are alternatives; they do not replace the current permitting system.

## FLORIDA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES (FDACS)

### *Florida Regulated Plant Index*

The Florida Regulated Plant Index (established pursuant to Section 581.185, F.S.) is administered and maintained by the FDACS Division of Plant Industry via Chapter 5B-40, F.A.C. Listed plant species are categorized as endangered, threatened, or commercially exploited. Permits for the taking, transport, and sale of plants on the Regulated Plant Index are reviewed by FDACS, but there is no provision for FDACS to regulate construction or other land alteration activities. *Halophila johnsonii* was listed as

an endangered species and subsequently removed from the Regulated Plant Index a few years prior to receiving federal listing. However, the statute provides for automatic addition of federally listed plants to the Regulated Plant Index.

*Florida Endangered Plant Advisory Council*

FDACS's Division of Plant Industry acts as liaison for the Endangered Plant Advisory Council (established under Section 581.186, F.S.) which serves to improve the protection of threatened, endangered, and commercially exploited plants species on the Regulated Plant Index. The council periodically examines listed species, as well as other native plants that have been proposed for inclusion on the Regulated Plant Index, to determine whether a particular plant species should be removed from the list, transferred to a different category, or added to the list.

FDACS Division of Agricultural Environmental Services regulates pesticide use within the state (via Chapter 487, F.S., and Chapter 5E, F.A.C.), and is responsible for coordinating state strategies to protect federally-listed threatened and endangered species from the use of pesticides.

LAND CONSERVATION ACT OF 1972

The Land Conservation Act of 1972 (Chapter 259, F.S.) establishes a land acquisition program to conserve and protect environmentally endangered lands in Florida. Criteria

for selecting lands includes consideration of important wildlife and plant habitats, including endangered and threatened species habitats.

## FLORIDA FOREVER ACT

The Florida Forever Act (FFA) (Chapter 259, F.S.), passed by the 1999 Florida Legislature, will go into effect as of July 2000. This act replaces the Florida Preservation 2000 Act which created a funding mechanism to support land acquisition programs in Florida and was implemented by Chapter 18-8, F.A.C., Conservation and Recreation Lands (CARL). Changes to this legislation are expected relative to the operation of the FFA. Federal listing of *H. johnsonii* may encourage land acquisition or other land conservation measures by the state.

## THE FLORIDA ENVIRONMENTAL LAND AND WATER MANAGEMENT ACT OF 1972

The Florida Environmental Land and Water Management Act of 1972 (Sections 380.10-12, F.S.) created the Area of Critical State Concern Program, which establishes a procedure for increased protection of lands of statewide importance, including critical habitat for threatened or endangered species. This act also establishes the Development of Regional Impact program, which requires that permit applications for certain large-scale developments affecting more than one county must undergo more stringent review, including review of the development's impact on wildlife habitat.

## STATE COMPREHENSIVE PLAN

The State Comprehensive Plan (Chapter 187, F.S.) includes goals and policies to conserve wildlife habitat and prohibit the destruction of endangered species and associated habitat. Local government comprehensive plans must be consistent with provisions in the state plan. Listing of *H. johnsonii* may encourage its conservation through Florida's planning procedures, supervised by the Florida Department of Community Affairs.

## FLORIDA NATURAL AREAS INVENTORY

The Florida Natural Areas Inventory (FNAI) was established in 1981 as a cooperative effort of FDEP and the Nature Conservancy. Funding for FNAI has been provided primarily by the CARL Trust Fund (authorized by Section 253.023, F.S.). One of the primary tasks of FNAI is to collect and disseminate information on the status and distribution of threatened and endangered species of plants and animals in Florida. These data facilitate environmentally sound planning and natural resource management. FNAI supports the listing of *H. johnsonii.*

## ST. JOHNS RIVER AND SOUTH FLORIDA WATER MANAGEMENT DISTRICTS

*Indian River Lagoon Surface Water Improvement and Management Plan (IRL SWIM) and Indian River Lagoon National Estuary Program Comprehensive Conservation and Management Plan (IRLCCMP)*

These plans list seagrass as the most critical habitat in the IRL, and have been developed with the goal of restoring the integrity and functionality of seagrass beds within this system (Steward et al. 1994, IRLNEP 1996).

**RECOVERY OF JOHNSON'S SEAGRASS**

A. Objectives and Criteria

*Halophila johnsonii* should be considered for delisting when the following conditions are met:

(1) The species' present geographic range is stable or increasing,

(2) Sufficient[1] self-sustaining populations[2] are present throughout the range to allow for stable vegetative recruitment, and

(3) Populations and supporting habitat in its geographic range have long-term protection (through regulatory action or purchase acquisition).

The number of self-sustainable individuals necessary, quality and quantity of habitat required, and possible method(s) of colonization to meet criteria (1), (2), and (3) need to be determined as recovery plan tasks.

B. Revision of Recovery Criteria

The recovery criteria may be revised on the basis of new information. A long-term research plan will be developed by a Johnson's Seagrass Research Council. The council core group will be members of the Recovery Plan Team. The research plan will be drafted during the 12 months following the Recovery Plan approval.

[1] Sufficient is when the distance between self-sustaining populations is <= the maximum dispersal distance.

[2] Self-sustaining population is a population that has been documented to persist for at least 10 years.

C. Recovery Tasks

**1. Identify and protect populations and habitat.**

Existing populations of *H. johnsonii* must be protected from present and foreseeable threats, including those that involve direct removal of the plant and/or adverse modification of its habitat. Protective management measures should be applied to entire habitats supporting Johnson's seagrass, concentrating on specific areas with one or more of the following criteria: 1) populations that have persisted for 10 years, 2) persistent flowering populations, 3) the northern and southern limits of the species, 4) unique genetic diversity, and 5) a documented high abundance of *H. johnsonii* compared to other areas in the species' range. Based on these criteria, ten areas in the geographic range of Johnson's seagrass were designated as critical habitat (65 FR 17768) (Appendix II). These ten areas and their approximate acreage include: a portion of the Indian River Lagoon, north of the Sebastian Inlet Channel (5.7); a portion of the Indian River Lagoon, south of the Sebastian Inlet Channel (2.0); a portion of the Indian River Lagoon near the Fort Pierce Inlet (4.3); a portion of the Indian River Lagoon, north of the St. Lucie Inlet (2770); a portion of Hobe Sound (900); a site on the south side of Jupiter Inlet (4.3); a site in central Lake Worth Lagoon (15.0); a site in Lake Worth Lagoon, Boynton Beach (95.5); a site in Lake Wyman, Boca Raton (20); and a portion of Biscayne Bay (18,700). This designated area accounts for approximately 7.0 percent of the species' total geographic range.

A long-term management program will be established based on special protection areas (areas having suitable habitat characteristics for supporting Johnson's seagrass). Elements such as state lands, aquatic preserves, acquisition, conservation agreements, easements, donations, or sanctuary arrangements will also be used for the protection of Johnson's seagrass populations and habitat.

1.01. Develop detailed baseline distribution maps (see Monitoring Section).

1.02. Identify areas with persistent populations.

1.03. Identify areas with flowering populations.

1.04. Protect genetically unique populations.

1.05. Identify areas of high abundance or areas that are conducive to the survival of the species.

1.06. Protect the geographic extremes of the range.

**2. Initiate a range-wide monitoring program.**

Factors affecting the recruitment, survival, and spread of a rare plant are complex (Schemske et al. 1994). For many seagrasses, little is known about their reproductive ecology, especially regarding the production and dispersal of sexual or asexual

propagules, two processes which are critical for their persistence or recovery. The patchiness and limited geographic range of *H. johnsonii* beds presents challenges and opportunities in monitoring the status of this rare species. Monitoring should provide information on the recruitment and mortality of patches as well as providing information on inter- and intra-patch dynamics. Because of the extremely limited latitudinal range of *H. johnsonii*, monitoring should detect any changes in the northern or southern distributional limits or range extensions of this species, i.e., intensive surveys should be undertaken to precisely determine these distributional boundaries and to especially assess their year-to-year stability. To satisfy the criteria for de-listing, there is also a critical need to determine if population stability is affected by patch size and spacing and whether this varies from north to south. Distribution maps have important implications regarding the stability of this rare species, and its ability to recover from stochastic perturbations that may eliminate individual patches or entire populations. Monitoring in the IRL indicates that there is spatial and temporal variation in abundance of *H. johnsonii* patches (Virnstein et al. 1997). Although the monitoring data are limited, no large distributional gaps have been detected in the IRL, and there has been no overall increase or decrease in abundance or geographic range over the period from summer 1994 to summer 1997. An important goal of the initial mapping would be to identify if any major distributional gaps presently exist in the southern part of the range.

Random sampling strategies, unless highly intense, are inappropriate for assessing the recovery potential for *H. johnsonii* because they could misrepresent the distribution and abundance of this species by having a relatively high probability for sample points to

miss patch beds. Rather, by surveying selected areas to locate *H. johnsonii* patches and establishing sampling stations both within and outside of patches, much information regarding patch dynamics can be gained. Because of *H. johnsonii*'s small size and understory, or its deep-edge growth habit and resolution limitations, aerial photography cannot be used to monitor changes in its distribution and abundance.

However, initial aerial photography surveys of the region from Jupiter Inlet south would be useful for locating potential seagrass-occurrence sites for subsequent ground-truthing surveys. The FWC-Bureau of Protected Species Management's 1999 dock study and 1996-1997 marina siting survey (Smith and Mezich 1999, Bureau of Protected Species Management 2000), and Palm Beach County Department of Environmental Resource Management (DERM) data (Palm Beach County DERM 1992, 1990) would also be useful for locating potential seagrass-occurrence sites. Spatially explicit, in-situ monitoring would then be required to verify distribution and abundance. The shoot density and cover within a statistically representative number of patches can be determined and tracked along with the variability of patch location and size (determined by DGPS) and the collection of a suite of environmental parameters thought to affect these characteristics (such as, optical water quality, water depth, and salinity). This combined tracking of information will allow correlative examination of the role of year-to-year environmental variation in affecting the vigor and abundance of this species. Monitoring should attempt to match up study sites with locations where current and past water quality data exist.

The relative contributions of vegetative growth and propagule dispersal versus sexual reproduction and seed recruitment (unknown for this species) on the maintenance, establishment, and genetic diversity of patches, needs to be understood for effective conservation and management (Schemske et al. 1994). The presence of numerous small patches across the marine landscape provides for an increased chance that some patches will survive perturbations and provide a recruitment source for post-impact recovery. Recent work on seagrass population genetics has demonstrated the importance of sampling over several spatial scales to determine the relative importance of various reproductive strategies to population establishment and maintenance, demography, and genetic diversity (Procaccini et al. 1996). This information is critical to resource managers in their evaluation of species recovery in the context of demonstrated spatial and year-to-year patterns of population distribution and abundance. An understanding of *H. johnsonii*'s population demography and the determination of whether numbers and sizes are expanding or declining should be the primary goals in a monitoring program.

2.01. Determine whether the distribution and size of beds are expanding or declining.

2.02. Determine the precise northern and southern distributional limits of *H. johnsonii* and monitor the temporal variation in these limits using DGPS and in-situ sampling (see Appendix 1, Recommendations for Sampling *H. johnsonii*).

2.03. Determine if patch size, abundance, or spacing vary from north to south, and identify if there are presently any large distribution gaps (see Protect Populations and Habitat section).

2.04. Establish permanent monitoring plots at (a) the northern and southern distribution limits, (b) the geographic extremes of the natural lagoon systems within the known geographic range (i.e., the southern end of the IRL and the northern end of Lake Worth), (c) sites with existing or long-term water quality data, and (d) sites identified to have unique or diverse genotypes present (e.g., Boynton Beach, Boca Raton, etc.). Annual monitoring should be conducted for 10 years to determine if criteria for de-listing have been met.

**3. Refine habitat requirements of *Halophila johnsonii.***

With no sexual reproduction, limited dispersal capability, and limited capacity to store energy and nutrients during periods of stress, *H. johnsonii* must sustain continuous vegetative growth and reproduction in order to replace natural mortality. *Halophila johnsonii* can persist/survive unfavorable conditions for only short periods of time; therefore, environmental conditions must be nearly continuously maintained for nearly continuous growth. Critical environmental factors to support seagrasses include, but are not restricted to: light, temperature, salinity, and unconsolidated sediments. Where *H. johnsonii* grows, conditions usually include light levels maintained at a minimum of 10% surface incident light, salinity of at least 15 ppt, water temperature between 10° C and 35° C, and sediments that are unconsolidated sand or sand mixed with silt-clay. The

affects of short-term poor conditions (i.e., low light or poor water quality) on *H. johnsonii* are currently unknown.

3.01. Maintain water quality and sediment conditions appropriate for continuous vegetative growth and reproduction of natural populations of *H. johnsonii* throughout its geographic range.

3.02 Establish a research council to develop a long-term research plan for the species.

3.03. Identify sites with and without *H. johnsonii*. At these sites, conduct a correspondence analysis between *H. johnsonii* distribution/abundance and environmental factors (habitat characteristics) including: temperature, salinity, light intensity, water motion, tidal exposure, sediment movement, and eutrophication.

3.04. Locate ephemeral populations of *H. johnsonii* and identify the characteristics (listed in 3.03) of these sites.

3.05. Identify the habitat characteristics which favor populations with female flowers (assuming male flowers should co-occur with females) and experimentally manipulate these conditions to attempt to induce flowering.

3.06. Conduct experiments to determine the effect of other seagrass species on the distribution and abundance of *H. johnsonii* and assess the similarity of habitat requirements between *H. johnsonii* and other species.

3.07. Determine if water quality and water management programs are appropriate for determining changes in conditions which would affect the continuous vegetative growth and reproduction of *H. johnsonii.*

3.08. Select and implement special protection areas throughout the geographic range of the species which have suitable environmental conditions for perennial and flowering populations.

**4. Conduct detailed life history studies of *Halophila johnsonii* to examine vegetative fragment dispersal, survival, and sexual reproduction.**

Initial field and mesocosm research, and surveys of natural populations, indicate that female flowers are formed in isolated populations, but there is still no report of the presence of male flowers. Male flowers are either non-existent or very rare, and asexual reproduction could be the primary means of growth and dispersal of this species. Yet there is evidence for a wide range of fluctuation in populations, and considerable efforts needed to explain and understand the recovery and colonization processes. Dispersal and recruitment by vegetative fragments is presumed to be an important mechanism for maintaining the disjunct populations of *H. johnsonii.* Research efforts should focus on determining the maximum dispersal distances by vegetative fragments, and the critical

life stages which are responsible for maintaining populations. Experimental design should cover the following:

4.01. Estimate new short shoot formation and death rates in natural populations and in experimental fragments manipulated in mesocosms under different environmental conditions.

4.02. Experimentally determine the mechanism for recruitment of patches (clones), and maximum dispersal distances of vegetative fragments.

4.03. Experimentally manipulate light, temperature, salinity, and nutrients to determine their effects on flowering and growth of vegetative fragments.

4.04. Collect and transplant fruits of *H. johnsonii* to determine whether fruits of *H. johnsonii* germinate and whether apomixis occurs.

**5. Determine habitat management needs and techniques.**

Maintenance of suitable habitat for this species will require use of management procedures necessary to alleviate or prevent degrading conditions (based on habitat requirements). Section 7(a)(2) of the ESA requires every federal agency to insure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat (50 CFR 402.01). Specific protective regulations for *H. johnsonii* will be

developed under section 4(d) of the ESA, and the feasibility of developing a 4(d) rule to extend take prohibitions to this threatened plant will be examined. Successful management will require an improvement in the accuracy of impact assessment on the species and its habitat and an examination of the interagency review process for projects that may impact the species and its habitat. Seagrasses are provided a greater level of protection from human activities on those state-owned submerged lands within designated aquatic preserves and within the boundaries of federally-designated areas. Existing regulatory authorities will be examined and applied to protect *H. johnsonii* and its habitat.

5.01. Federal and state agencies adopt sampling protocols for *H. johnsonii* for the permit application and monitoring requirements at a project site (see Appendix 1).

5.02. Incorporate *H. johnsonii* post-construction monitoring distribution and abundance data into a centralized GIS tracking system to improve protection and management (through permit tracking) and to determine cumulative impacts.

5.03. Provide educational opportunities and workshops for federal and state permitting agencies, including training in field identification, sampling protocols, and the identification of designated critical habitat.

5.04. Establish federal and state interagency coordination during the permit review process (e.g., NMFS, COE, FDEP, SJRWMD, SFWMD) for projects that may affect *H. johnsonii* or its habitat so that impacts to the species can be eliminated or reduced.

5.05. Implement management actions that will improve or maintain water quality conditions and coordinate these actions with already existing programs, including, but not exclusively, the Indian River Lagoon National Estuary and SWIM programs and the Lake Worth Management Plan.

5.06. Establish Pollutant Load Reduction Goals (PLRG) for a specific water body or segment within a water body, describing the management actions required to reach these guidelines (including stormwater treatment, wastewater reuse, and best management practices for upland use).

5.07. Monitor water bodies, or the segments within, for the predicted responses of water quality and seagrass to the implementation of management actions.

5.08. Assess current federal, state, and local seagrass protection regulations (specifically those that provide a level of protection from human activities on submerged lands and within the boundaries of federally-designated areas) for their level of effectiveness in protecting *H. johnsonii* and its habitat.

5.09. Assess enforcement efforts of existing submerged lands/seagrass protection regulations.

5.10. Develop specific protective regulations for *H. johnsonii* under 4(d) of the ESA.

5.11. Identify and recommend the acquisition of privately-owned submerged land vegetated with *H. johnsonii* and its adjacent uplands through local, regional, state and federal programs. Public acquisition of these few tracts will preserve the seagrass habitat associated with them and provide upland watershed buffer protection.

5.12. Preserve natural shoreline buffers on waterfront properties and encourage shoreline restoration.

5.13. Implement a multi-agency and methods approach management program to reduce prop scarring of shallow water seagrass beds. The management program should include increased boater education, installing channel markers, active enforcement, and establishing limited motoring zones. Over the long term, this comprehensive approach should reduce scarring to levels that do not significantly affect habitat quality and quantity.

5.14. Establish "adverse modification" and "jeopardy" guidelines for *H. johnsonii* for use in section 7 consultation under the ESA.

**6. Identify the genetic diversity and genetic structure of *Halophila johnsonii* across its geographic range.**

The genetic diversity of clonal plants depends strongly on the relative proportions of sexual versus asexual reproduction (Hamrick et al. 1979). Although only asexual reproduction is presently known for this species (because of the apparent absence of male flowers) and little genetic variation has been documented (Jewett-Smith et al. 1997), limited genetic variation within, and among, patches may be possible due to somatic mutation and genetic drift (Loveless and Hamrick 1984). Preliminary surveys using Randomly Amplified Polymorphic DNA (RAPD) analyses indicate that there are small, isolated populations of *H. johnsonii* that have clones which are genetically distinct from clones at other locations (Freshwater 1999). Two populations in the more southerly range of the species, one from near Boynton Beach and a second population from Boca Raton, exhibit higher genetic variability than populations from the central (Jupiter Inlet) and northern range (Fort Pierce Inlet, Johns Island, Sebastian Inlet) of the species. Since there are no known occurrences of male flowers, it is suspected that the extant populations of *H. johnsonii* are maintained almost exclusively by clonal growth and asexual reproduction. Consequently, gene flow may be severely restricted because of very infrequent or no genetic recombination, and the current variation in *H. johnsonii* may be due to somatic mutation associated with asexual reproduction and clonal growth. If this is the case, these isolated clones serve as important reservoirs of genetic information for the species and should be protected. Genetic studies should continue to determine if other pockets of higher genetic diversity exist, especially at the southern extreme of this species' range. These studies should also look for genetic indicators of

sexual reproduction and utilize more sophisticated methods to identify the number of genetic individuals present in the species range. However, even if sexual reproduction or dispersal of fragments occurs, physical isolation resulting from the disjunct distribution of this species may still pose a threat to its persistence because of negative effects of inbreeding and clonal reproduction. Additional studies should determine whether indices of genetic diversity are correlated with species persistence. If the genetic composition of populations is linked to ecologically important processes such as growth rate and survival, then these traits and genotypes can be identified in specific populations and targeted for protection.

6.01. Determine the range of genetic variability and identify genetically unique populations within the species' geographic range.

6.02 Determine if indices of genetic diversity are correlated with species persistence.

**7. Develop restoration techniques.**

Because of its apparent lack of sexual reproduction, inability to disperse by sexual propagules, and its small and relatively fragile stature, *H. johnsonii* may have a limited capacity for recovering from disturbance or total destruction (removal). The extant populations are comprised mainly of non-contiguously distributed patches which limits the ability of the plant to recover from disturbance by vegetative encroachment from adjacent undisturbed populations. Natural recruitment and recovery of *H. johnsonii* within localized populations may be substantial. However, because of the limited or

lack of sexual reproduction in this species, the recovery of lost populations may be enhanced by transplantation of natural or cultivated vegetative fragments.

7.01. Conduct mesocosm laboratory and field experiments to test the feasibility of transplanting vegetative fragments of *H. johnsonii* under a broad range of environmental conditions.

7.02. Conduct transplant experiments in the field and mesocosms to assess the relative importance of the environmental factors and their interactions in controlling the distribution and abundance of *H. johnsonii.*

7.03. Identify populations of *H. johnsonii* with superior growth and survival characteristics under different transplanting conditions and develop reliable methodologies for transplanting.

7.04. Verify superior populations by conducting reciprocal transplants between field sites of: different water depths, different salinities, different geographical ranges, and different genetic stocks. In these experiments identify key growth and demographic characteristics that distinguish the source and the surviving transplant populations.

7.05. Utilize mesocosms to experimentally test the superiority of different transplant stocks.

7.06. Develop a cultivation facility to maintain superior stocks of *H. johnsonii* for restoration of damaged and lost populations.

**8. Formulate an educational outreach program to increase awareness of Johnson's seagrass and its status.**

*Halophila johnsonii* because of its limited geographic range, reliance on vegetative growth, and patchy distribution, may have the most limited distribution of any seagrass on earth. It is the first marine plant species to be listed under the ESA. Recovery objectives, based on its threatened listing, are to a) prevent the species from declining to an endangered status, and b) delist the species based on the criteria stated at the beginning of this recovery chapter. An education outreach program will address the status of *H. johnsonii*, threats to the species and its habitat, and management needs for protecting and conserving this species.

Risks of destruction to *H. johnsonii* and its habitat include 1) dredging, 2) shading from over-water structures, 3) prop scouring and anchor mooring, 4) trampling, 5) altered water quality (such as stormwater runoff and turbidity), 6) storms, and 7) siltation. Education outreach will address both anthropogenic and natural threats, and will be tailored to public citizens, fishers and boaters, as well as to private and public agencies (including the COE, USCG, Federal Highway Administration, Florida Department of Transportation) involved with projects or activities that may affect *H. johnsonii* or its habitat.

The education efforts for *H. johnsonii* will assist in raising awareness for all seagrass habitats, the valued role that seagrass beds play in the marine environment, threats on shallow coastal lagoon ecosystems (where human impacts are great), and the overall decline of seagrass species despite existing protective regulations for submerged lands. It will be important to integrate education of *H. johnsonii* into already existing protection plans or education programs, such as the IRL National Estuary and SWIM programs, State of Florida Coastal and Aquatic Managed Areas, and the Lake Worth Management Plan.

8.01. Develop Web Page - post update on recovery efforts.

8.02. Adapt existing education tools such as pamphlets and brochures on Florida seagrasses to address *Halophila johnsonii* protection.

8.03. Coordinate with media; conservation groups/local plant societies to develop a positive understanding of seagrasses/*H. johnsonii.*

8.04. Develop and evaluate educational materials and curricula with schools and local environmental centers that introduce students to seagrasses, making sure to incorporate information on *H. johnsonii*, its habitat, and the ESA.

8.05. Develop and present state/federal/Water Management District regulatory workshops on survey protocol, effects of actions on *H. johnsonii*, and basic biology and proper identification of the species.

**IMPLEMENTATION SCHEDULE**

Priorities in Column 1 of the Implementation Schedule are assigned as follows:

Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2 - An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to provide for full recovery of the species.

**Abbreviations for Implementation Schedule**

| | |
|---|---|
| BPSM | FWC Bureau of Protected Species Management |
| CAMA | Bureau of Coastal and Aquatic and Managed Areas |
| CARL | Conservation and Recreation Lands |
| COE | U.S. Army Corps of Engineers |
| DERM | Department of Environmental Resources Management |
| ESA | Endangered Species Act |
| DGPS | Digital Global Positioning System |
| FDACS | Florida Department of Agriculture and Consumer Services |
| FDEP | Florida Department of Environmental Protection |
| FWC | Florida Fish and Wildlife Conservation Commission* |
| FMRI | FWC/Florida Marine Research Institute |
| GIS | Geographic Information System |
| HBOI | Harbor Branch Oceanographic Institute |
| NEP | National Estuary Program |
| NGOs | Non-governmental Organizations |
| OCAMA | FDEP/Office of Coastal and Aquatic Managed Areas |
| OIS | FWC/Office of Information Services |
| NOAA | National Oceanographic and Atmospheric Association |
| PLRGs | Pollution Load Reduction Goals |
| RFP | Request For Proposals |
| SJRWMD | St. Johns River Water Management District |
| SFWMD | South Florida Water Management District |
| SWIM | Surface Water Improvement and Management Act |
| UNC-Wilm. | University of North Carolina - Wilmington |
| WMDs | SJRWMD and SFWMD |

*An office or bureau of FWC other than FMRI; such as Marine Resources, Bureau of Protected Species Management (BPSM).

## *Halophila johnsonii* Implementation Schedule

| IMPLEMENTATION SCHEDULE | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | RESPONSIBLE PARTY | | COST ESTIMATES ($K) | | | |
| PRIORITY # | TASK # | TASK DESCRIPTION | TASK DURATION | | OTHER | FY 1 | FY 2 | FY 3 | COMMENTS/NOTES |
| 1 | 1.01 | Develop detailed baseline distribution maps. | 2-3 yrs., repeat every 5 yrs. | NOAA, WMDs, FWC/FMRI, FDEP/CAMA | County DERM Offices | 100 | 100 | 100 | GIS and ground truthing. Build on present database. GIS database at NOAA or FMRI. Link with tasks 1.01, 1.02, 1.03, 2.03, and, 2.04. |
| 1 | 1.02 | Identify areas with persistent populations. | 10 yrs. | NOAA, SJRWMD | FWC/ BPSM, County DERM | 30 | 30 | 30 | |
| 1 | 1.03 | Identify areas with flowering populations. | 5-10 yrs. | NOAA, FWC/FMRI | | 10-15 | 10-15 | 10-15 | Diver survey for 1 month/year, GIS. Link with task 1.01. Develop and issue request for proposals. |
| 1 | 1.04 | Protect genetically unique populations. | continuous | NOAA | contract | 50 | 30 | 30 | |
| 1 | 1.05 | Identify areas of abundance or areas that are conducive to the survival of the species. | 2 yrs. | FWC/FMRI, WMDs | | | | | Subtask to 1.01 and 1.02. |
| 1 | 1.06 | Protect the geographic extremes of the range. | continuous | NOAA | FDEP, WMDs, FWC/ FMRI | 50 | 50 | | Cost depends on level of protection. incorporate into regulatory process. |

| PRIORITY # | TASK # | TASK DESCRIPTION | TASK DURATION | | OTHER | FY 1 | FY 2 | FY 3 | COMMENTS/NOTES |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.01 | Determine whether the distribution and size of beds are expanding or declining. | 10 yrs. | NOAA, WMDs | COE | 30 | 30 | 30 | Annual monitoring part of task 2.04. Develop GIS database. |
| 1 | 2.02 | Determine the precise northern and southern distributional limits of *H. johnsonii* and monitor the temporal variation in these limits using DGPS and in-situ sampling. | 10 yrs., continuing | SJRWMD, County DERM, | | 5 | 5 | 5 | Annual patch mapping, GIS. Link with tasks 1.01, 2.03, and 2.04. |
| 2 | 2.03 | Determine if patch size, abundance, or spacing vary from north to south and identify if there are presently any large distribution gaps. | 3-5 yrs. | WMDs, FWC/FMRI | County DERM | 150 | 150 | 150 | GIS, Link with task 1.01. |
| 2 | 2.04 | Establish permanent monitoring plots at (a) the northern and southern distribution limits, (b) the geographic extremes of the natural lagoon systems within the known geographic range, (c) sites with existing or long-term water quality data, and (d) sites identified to have unique genotypes present. | 10 yrs. continuous | SJRWMD, FDEP/ OCAMA | County DERM | 100-120 | 100 | 100 | Sampled once/year. Link with task 2.02. |
| 1 | 3.01 | Maintain water quality and sediment conditions appropriate for continuous vegetative growth and reproduction of natural populations of *H. johnsonii* throughout its geographic range. | continuous | FDEP, WMDs | County DERM, COE | | | | Clean Water Act. Task already being accomplished based on Water Quality Standards. |
| 3 | 3.02 | Establish Research Council | semi-annually | NOAA | WMDs, FWC/ FMRI, FDEP, COE | 25 | 25 | 25 | To begin immediately. |

| PRIORITY # | TASK # | TASK DESCRIPTION | TASK DURATION | | OTHER | FY 1 | FY 2 | FY 3 | COMMENTS/NOTES |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 3.03 | Identify sites with and without *H. johnsonii*. At these, conduct a correspondence analysis between *H. johnsonii* distribution/abundance and environmental factors (habitat characteristics) including; temperature, salinity, light intensity, water motion, tidal exposure, sediment movement, and eutrophication. | 2-5 yrs. | NOAA, WMDs | County DERM, FWC/ FMRI | 100 | 100 | 50 | GIS statistical analyses. Part of baseline. Link with tasks 1.01, 2.02, 3.04. |
| 2 | 3.04 | Locate ephemeral populations of *H. johnsonii* and identify the characteristics (as determined by 3.03) of these sites. | >5 yrs. | NOAA, WMDs | FWC/ FMRI | 30 | 30 | | Combine with tasks 1.01, 1.02, 3.03, and 3.05. |
| 2 | 3.05 | Identify the habitat characteristics which favor populations with female flowers (assuming male flowers should co-occur with females) and experimentally manipulate these conditions to attempt to induce flowering. | 2 yrs. | NOAA | FWC/ FMRI | 15 | 10 | 10 | Combine with task 3.04, 1.01, and 1.02.<br>First need to determine if female flowers contribute to recruitment. |
| 3 | 3.06 | Conduct experiments to determine the effect of other seagrass species on the distribution and abundance of *H. johnsonii* and assess the similarity of habitat requirements between *H. johnsonii* and other species. | 2-5 yrs. | NOAA, FDEP | COE, WMDs, FWC/ FMRI | 50 | 50 | 50 | Combine with task 3.03.<br>In-situ and mesocosm experiments.<br>Develop and issue request for proposal: grant, contract. |
| 3 | 3.07 | Determine if water quality and water management programs are appropriate for determining changes in conditions which would affect the continuous vegetative growth and reproduction of *H. johnsonii*. | 1-2 yrs. | NOAA, FDEP | WMDs | 20-30 | 20-30 | | Post-doc biology statistician. |

| PRIORITY # | TASK # | TASK DESCRIPTION | TASK DURATION | | OTHER | FY 1 | FY 2 | FY 3 | COMMENTS/NOTES |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.08 | Select and implement special protection areas throughout the geographic range of the species which have suitable environmental conditions for perennial and flowering populations. | 1-2 yrs. | NOAA, FDEP | FWC, COE | 15 | 10 | | Establish preserve in critical areas. Possibly National Estuarine Research Reserve. |
| 2 | 4.01 | Estimate birth and death rates in natural populations and in experimental fragments manipulated in mesocosms under different environmental conditions. | 2-3 yrs. | NOAA | | 50 | 30 | 30 | Task 4.01 to be combined with task 4.02 in same study. Develop and issue request for proposal: grant, contract. |
| 1 | 4.02 | Experimentally determine the mechanism for recruitment of patches (clones) and maximum dispersal distances of vegetative fragments. | 3-5 yrs. | NOAA, SJRWMD | FWC/ FMRI | 30 | 30 | 30 | To be combined with Task 4.01 in same study. |
| 3 | 4.03 | Experimentally manipulate light, temperature, salinity and nutrients to determine their effects on flowering and growth of vegetative fragments. | 2-3 yrs. | NOAA | FWC/ FMRI | 40 | 20 | 20 | Mesocosm experiments. Develop and issue request for proposal: grant, contract. |
| 2 | 4.04 | Collect and transplant mature fruits of *H. johnsonii* to determine whether fruits of *H. johnsonii* germinate and whether apomixis occurs. | 1-3 yrs. | NOAA | | 25 | | | Link with task 7.02. Also individual monitoring of plants. Develop and issue request for proposal: grant, contract. |
| 1 | 5.01 | Adopt sampling protocols for the permit application and monitoring requirements for *H. johnsonii*. | 1-2 yrs. | FDEP, WMDs, COE | FWC/ BPSM | 5 | 1 | 1 | Link with 2.04 and 5.03. Costs are for agency/public workshops. |
| 2 | 5.02 | Incorporate *H. johnsonii* post-construction monitoring distribution and abundance data into centralized GIS tracking system to improve protection and management (through permit tracking) and to determine cumulative impacts. | 1-2 yrs., ongoing | NOAA (and contractor), COE | FDEP, WMDs | 20 | 5-10 | 5-10 | Put into permit requirement. Should be done in conjunction with 2.04 and 8.04. Requires setting up GIS database |

| PRIORITY # | TASK # | TASK DESCRIPTION | TASK DURATION | | OTHER | FY 1 | FY 2 | FY 3 | COMMENTS/NOTES |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 5.03 | Provide educational opportunities and workshops for federal and state permitting agencies, including training in field identification, sampling protocols, and critical habitat. | Periodic intervals annually | NOAA, COE, FDEP | WMDs, FWC/ BPSM | 25 | 25 | | Cross-reference with tasks 8.01-8.05.<br>(10K-meeting; 20K - Full Time Employee)<br>Costs to hold workshop in year 1 and print brochure in year 2. |
| 1 | 5.04 | Establish federal and state interagency coordination during the permit review process (e.g., NOAA, COE, FDEP, SJRWMD, SFWMD) for projects that may affect *H. johnsonii* or its habitat so that impacts to the species can be eliminated or reduced. | 6-9 months, within 1 year | NOAA, COE, FDEP, WMDs | FWC/ BPSM | 50 | | | Travel costs for meeting to establish the process. |
| 3 | 5.05 | Implement management actions that will improve or maintain water quality conditions and coordinate these actions with already existing programs, including, but not excusively, the Indian River Lagoon National Estuary and SWIM programs, and the Lake Worth Management Plan. | Initially 1-2 yrs., continuous | FDEP, WMDs, NEP | | ongoing | | | Incorporate, where feasible, into currently existing regulations.<br>Link with task 5.0.<br>Monitoring and enforcement under tasks 1.06 and 5.01. |
| 2 | 5.06 | Establish Pollutant Load Reduction Goals (PLRGs) for specific water body or segment within a water body, describing the management actions required to reach these guidelines (including stormwater treatment, waste water reuse, and best management practices for upland use). | 5 yr.s | FDEP, WMDs | | 20 | | | Link with tasks 3.05, 3.07, and 4.03.<br>Being done in Indian River Lagoon for seagrass in general. |
| 3 | 5.07 | Monitor water bodies, or the segments within, for the predicted responses of water quality and seagrass to the implementation of management actions. | Continuous | WMDs, FDEP | DERM | | | | Link to tasks 3.07 and 4.03.<br>Link with monitoring designs and costs of task 2.04. |

| PRIORITY # | TASK # | TASK DESCRIPTION | TASK DURATION | | OTHER | FY 1 | FY 2 | FY 3 | COMMENTS/NOTES |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 5.08 | Assess current federal, state and local seagrass protection regulations (specifically those that provide a level of protection from human activities on state-owned submerged lands and within the boundaries of federally-designated areas) for their level of effectiveness in protecting *H. johnsonii* and its habitat. | On-going | NOAA, FDEP, FWC | | | | | Partially addressed in Recovery Plan, Chapter 1. Link with task 3.07. |
| 1 | 5.09 | Assess enforcement efforts of existing submerged land/seagrass protection regulations. | 6 mos.-1 yr. | NOAA, FDEP, FWC | | 5-10 | | | Link with tasks 3.07, 5.04 and 5.05. |
| 2 | 5.10 | Develop specific protection regulations for *H. johnsonii* as necessary under section 4(d) of the ESA. | 1-2 yrs. | NOAA, FDEP | COE, FWC/ FMRI | | | | Link with tasks 5.04 and 5.05. Will assist in permitting process. |
| 3 | 5.11 | Identify and recommend the acquisition of privately-owned submerged lands vegetated with *H. johnsonii* and its adjacent uplands. | continuous | WMDs, FDEP | DERM, NOAA, NGOs | | | | CARL project. Cost depends on acquisition costs. Utilize 2000 SWIM programs. Enter into baseline GIS as acquired: task 1.01. |
| 3 | 5.12 | Preserve natural shoreline buffers on waterfront properties and encourage shoreline restoration. | continuous | FDEP, DERM | COE, NEP, WMDs, FWC | | | | Link to task 8.0. Should be part of FDEP, county existing programs. |
| 3 | 5.13 | Implement a multiple agency and methods approach management program to reduce prop scarring of shallow water seagrass beds. | 2-5 yrs. | NOAA, NEP, FDEP, FWC | | 50 | | | Link with ongoing FDEP efforts. Link with 8.01. |
| 2 | 5.14 | Establish "adverse modification" and "jeopardy" guidelines for *H. johnsonii* for use in Section 7 consultation under the ESA. | 1 yr. | NOAA | COE | | | | |

| PRIORITY # | TASK # | TASK DESCRIPTION | TASK DURATION | | OTHER | FY 1 | FY 2 | FY 3 | COMMENTS/NOTES |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 6.01 | Determine the range of genetic variability and identify genetically unique populations within the species' geographic range. | 1-2 yrs. | NOAA | | 40 | 30 | | Link with task 1.04, 2.03, 3.02, 4.02. Develop and issue request for proposal: grant, contract. |
| 2 | 6.02 | Determine if indices of genetic diversity are correlated with species persistence. | up to 5 yrs. | NOAA | | 150 | 100 | 40 | Link with tasks 4.01, 4.02, and 7.02 in single study. |
| 1 | 7.01 | Conduct mesocosm laboratory and field experiments to test the feasibility of transplanting vegetative fragments of *H. johnsonii* under a broad range of environmental conditions. | 2-3 yrs. | NOAA | contract-ors | 40 | 40 | 20 | Link with tasks 4.01, 4.02, and 7.01 in single study. Develop and issue request for proposal: grant, contract. |
| `2 | 7.02 | Conduct transplant experiments in the field and mesocosms to assess the relative importance of the environmental factors and their interactions in controlling the distribution and abundance of *H. johnsonii*. | 3 yrs. | NOAA | WMDs | 40 | 40 | | Link with tasks 2.04, 4.01, 4.02. |
| 3 | 7.03 | Identify populations of *H. johnsonii* with superior growth and survival characteristics under different transplanting conditions and develop reliable methodology for transplanting. | 2-3 yrs. | NOAA | FWC/ FMRI | 50 | 50 | 50 | Link with tasks 2.04, 4.02, and 4.03. Tasks 7.03, 7.04, and 7.05 to be combined in one request for proposal. |
| 3 | 7.04 | Verify superior populations by conducting reciprocal transplants between field sites of: different water depths, different salinities, different geographical ranges, different genetic stocks. In these experiments identify key growth and demographic characteristics that distinguish the source and the surviving transplant populations. | 2-3 yrs. | NOAA | FWC/ FMRI | 75 | 75 | 75 | Link with tasks 4.02, 7.03, and 7.05. Develop and issue request for proposal: grant, contract. |

| PRIORITY # | TASK # | TASK DESCRIPTION | TASK DURATION | | OTHER | FY 1 | FY 2 | FY 3 | COMMENTS/NOTES |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 7.05 | Utilize mesocosms to experimentally test the superiority of different transplant stocks. | ongoing, 2-5 yrs. | NOAA | FWC/ FMRI | 40 | 40 | | Link with tasks 4.02, 4.03, 7.03, and 7.04. Develop and issue request for proposal: grant, contract. |
| 3 | 7.06 | Develop a cultivation facility to maintain superior stocks of *H. johnsonii* for restoration of damaged and lost populations. | ongoing, 1-2 yrs. initially, then continuous. | NOAA | FWC/ FMRI | 50 | 10 | 5 | Link with task 4.02. Continuing. Costs depends on personnel. State facility maintains stocks from tasks 7.03-7.05. |
| 3 | 8.01 | Develop web page - post update on recovery efforts. | 4 months-1 yr., then continuous | NOAA | FDEP | 10 | 10 | 10 | A task for an existing webmaster. |
| 3 | 8.02 | Utilize existing educational forums such as pamphlets and brochures on Florida seagrasses. | 1-2 yrs, continual supply | NOAA, FDEP, FWC | | 20 | 20 | | In existing Environmental Information (E&I)/Outreach and Education departments. Contribute to printing costs. Link tasks 8.02, 8.03, and 8.04. |
| 3 | 8.03 | Coordinate with media; conservation groups/local plant societies to develop a positive understanding of seagrass/Johnson's seagrass. | ongoing | NOAA, FDEP | FWC/ OIS, FDACS, NEP | minimal but may require work-shops | | | Utilize Public Relations personnel. Cost of brochures and teaching aids. Use existing programs. |
| 3 | 8.04 | Develop and evaluate educational materials and curricula with schools and local environmental centers that introduce students to seagrasses, making sure to incorporate information on *H. johnsonii*, its habitat, and the ESA. | 1 yr., continual | NOAA, FDEP, FWC/OIS, FDACS | | 15 | | | Utilize input from tasks 1.01, 2.04, 3.05, 4.03, 5.03, 5.14, 7.01, and 8.02. Link with essential fish habitat and faunal survey. Input of Dept. of Education and local districts |

| PRIORITY # | TASK # | TASK DESCRIPTION | TASK DURATION | | OTHER | FY 1 | FY 2 | FY 3 | COMMENTS/NOTES |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 8.05 | Develop and present state/federal/Water Management District regulatory workshops on survey protocol, effects of actions on *H. johnsonii,* and basic biology and proper identification of the species. | Several times during first year. One every 2-3 years. | NOAA, FDEP, WMDs, FWC/ OIS, FDACS | | 25 | 0 | 25 | Link with tasks 5.02, 5.03. Utilize tasks 1.01, 2.04, and 4.03. Needed workshops, use existing programs. |

## APPENDIX I

**Listing Notice for *Halophila johnsonii***
**Federal Register 63(177): 49035**

**BILLING CODE 4310–55–P**
**DEPARTMENT OF COMMERCE**
**National Oceanic and Atmospheric Administration**
**50 CFR Part 227**
**[Docket No. 980811214–8214–01; I.D.**
**052493B]**
**Endangered and Threatened Species;**
**Threatened Status for Johnson's Seagrass**
**AGENCY:** National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.
**ACTION:** Final rule.
**SUMMARY:** NMFS is issuing a final rule determining Johnson's seagrass *(Halophila johnsonii)* to be a threatened species pursuant to the Endangered Species Act (ESA) of 1973, as amended, which means it is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Johnson's seagrass is rare and exhibits one of the most limited geographic distributions of any seagrass. Within its limited range (lagoons on the east coast of Florida from Sebastian Inlet to central Biscayne Bay), it is one of the least abundant species. Because of its limited reproductive capacity (apparently only asexual) and limited energy storage capacity (small root-rhizome structure and high biomass turnover), it is less likely to be able to repopulate an area when lost due to anthropogenic or natural disturbances. NMFS will soon issue protective regulations under section 4(d) of the ESA for this species.
**DATES:** Effective October 14, 1998.
**ADDRESSES:** Colleen Coogan, NMFS, Southeast Region, Protected Resources Division, 9721 Executive Center Drive, St. Petersburg, FL 33702–2432; Angela Somma, NMFS, Office of Protected Resources, 1315 East-West Highway, Silver Spring, MD 20910.
**FOR FURTHER INFORMATION CONTACT:**
Colleen Coogan, Southeast Region, NMFS, (727) 570–5312, or Angela Somma, Office of Protected Resources, NMFS, (301) 713–1401.
**SUPPLEMENTARY INFORMATION:**
**Background**
NMFS published a proposed rule to list Johnson's seagrass as a threatened species on September 15, 1993 (58 FR 48326). Designation of critical habitat was proposed on August 4, 1994 (59 FR 39716). A public hearing on both the proposed listing and critical habitat designation was held in Vero Beach, Florida, on September 20, 1994. NMFS reopened the comment period for the proposed listing on April 20, 1998 (63 FR 19468).
The information forming the basis for NMFS' 1993 proposal has been peer reviewed, and new information confirms NMFS' conclusions regarding the threatened status of Johnson's seagrass. As stated in the notice reopening the comment period, the additional information supplements available data on the status and distribution of Johnson's seagrass. In order to update the original status report (Kenworthy, 1993) and to include information from new field and laboratory research on species distribution, ecology, genetics and phylogeny, NMFS convened a workshop on the biology, distribution, and abundance of H. *johnsonii*. The results of this workshop, held in St. Petersburg, Florida, in November 1996, were summarized in the workshop proceedings (Kenworthy, 1997) submitted to NMFS on October 15, 1997. The notice reopening the comment period contains a summary of the workshop proceedings (63 FR 19468). This final rule contains a brief description of those workshop proceedings, and updates the research findings and analysis since NMFS' 1993 proposal.
**Updated Status Report**
The biology of Johnson's seagrass is discussed in the proposed rule to list the species as threatened (58 FR 48326, September 15, 1993). The proposed rule includes information on the status of the species, its life history characteristics, and habitat requirements. Johnson's seagrass is one of twelve species of the genus *Halophil*a. *Halophila* species are distinguished morphologically from other seagrasses in their possession of either a pair of stalked leaves without scales or a pseudo whorl of leaves. Identifying characteristics of H. *johnsonii* include smooth foliage leaves in pairs 10–20 mm long, a creeping rhizome stem, sessile (attached to their bases) flowers, and longnecked fruits. Most *Halophila* species are reduced in size, more shallow rooted, and have two to three orders of magnitude less biomass per unit area compared to all other seagrasses. The most outstanding difference between H. *johnsonii* and other species is its distinct differences in sexual reproductive characteristics. While H. *decipiens* is monoecious (has both female and male flowers on the same plant) and successfully reproduces and propagates by seed, H. *johnsonii* is dioecious (has flowers of a single sex on the same plant). However, the maleflower has never been described either in the field or in laboratory culture. The absence of male flowers supports the hypothesis that sexual reproduction is absent in this species, and propagation must be exclusively vegetative. After periods of unfavorable environmental conditions of growth and vegetative branching, the regrowth and reestablishment of surviving populations of Johnson's seagrass would be significantly more difficult than for species with a sexual life history.
**49036**
The status review that led to the proposed rule to list this species as threatened under the ESA included data from extensive field work at three sites (Hobe and Jupiter sounds, Sebastian Inlet, and Ft. Pierce Inlet) in the

Indian River area during 1990 to 1992. Johnson's seagrass was the least abundant of the seagrass species within the study area and was distributed in patches that range in size from a few centimeters to hundreds of meters. Biomass, patch sizes, and leaf pair densities were always less than those measured in H. *decipien*s. The destruction of the benthic community due to boating activities, propeller dredging and anchor mooring was observed at all sites during this study. Based on new qualitative and quantitative benthic surveys and interviews with scientists, the workshop report confirmed the extremely limited geographic distribution of *H. johnsonii* to patchy and vertically disjunct populations between Sebastian Inlet and northern Biscayne Bay on the east coast of Florida, finding no verifiable sightings outside the range already reported. Since additional surveys did not locate any male flowers, nor was seedling recruitment confirmed, the restricted distribution and abundance of Johnson's seagrass is attributed to areliance on vegetative means of reproduction and growth (Kenworthy, 1993; Kenworthy, 1997). High densities of apical meristems, rapid rates of horizontal growth, and a fast biomass turnover were suggested to explain the appearance and disappearance of *H. johnsonii* observed in disturbed areas and on fixed survey transects. The workshop report confirms the conclusions from the previous data.

The results of expanded surveys during the period 1994 to 1996 corroborated previous information that: (1) *H. johnsonii* does not occur further north than Sebastian Inlet; and (2) areal distribution is patchy and disjunct from Sebastian Inlet to Jupiter Inlet. Additionally, these transects confirmed that *H. johnsonii* occurs over a depth range extending from the intertidal down to approximately –2 m mean tidal height. Average percent cover of *H. johnsonii* per transect ranged from a minimum of 0.2 percent in winter 1996 to 8.5 percent in summer 1994. Relative to the other six species that occur in the lagoon, *H. johnsonii* comprises less than 1.0 percent of the total abundance of seagrasses. The transect data corroborates previous intensive surveys in Jupiter and Hobe sounds, and near Fort Pierce Inlet (Kenworthy, 1993; Gallegos and Kenworthy, 1995; Kenworthy, 1997). The potential for vegetative expansion, a perennial and intertidal growth habit, and a relatively high tolerance for fluctuating salinity and temperature may enable Johnson's seagrass to colonize and thrive in environments where other seagrasses cannot survive (Kenworthy, 1993; Kenworthy, 1997). Additional molecular genetic information was reviewed in the workshop which supports distinguishing *H. johnsonii* as a separate species from *H. decipiens* (Kenworthy, 1993), although more detailed and extensive phylogenetic studies were suggested to determine the origin and source of genetic diversity in Johnson's seagrass (Kenworthy, 1997). The first quantitative evidence of faunal community diversity and abundance in *H. johnsonii* meadows was also reported at this workshop. Results indicated that the infaunal communities of *H. johnsonii* are more similar to the larger seagrass, *Halodule wrightii* than to unvegetated bottom.

It is the policy of NMFS and the U.S. Fish and Wildlife Service (FWS) to solicit the expert opinions of three appropriate and independent specialists regarding pertinent scientific or commercial data and assumptions relating to the taxonomy, population models, and supportive biological and ecological information for species under consideration for listing. Also, it is NMFS' policy to summarize in the final decision document the opinions of all independent peer reviews received and to include all such reports, opinions, and other data in the administrative record of the final decision.

In response to NMFS's three solicitations of peer review on Johnson's seagrass, a response was received from Susan Williams, Ph.D., Associate Professor, Department of Biology and Director, Coastal and Marine Institute, College of Sciences, San Diego State University and from Kimon T. Bird, Ph.D., Center for Marine Science Research, University of North Carolina at Wilmington. Their opinions, which support the NMFS listing proposal, areincluded in the following Summary of Comments section.

**Summary of Comments**

The State of Florida's Department of Environmental Protection (FDEP) and Department of Community Affairs (DCA) submitted several sets of comments. Many of these comments pertained to the consideration of critical habitat designation, which is not being determined in this rulemaking. For this present rule, NMFS will address only the comments related to the listing of Johnson's seagrass as threatened. The December 8, 1993, comments from FDEP concurred that threatened status under the ESA should be assigned to Johnson's seagrass because its distribution is among the most restricted of seagrass species, because it lacks sexual reproduction, and because it depends on vegetative reproduction. All of these factors make it particularly vulnerable to local extinction from various perturbations or environmental changes.

FDEP stated that *johnsonii* and other *Halophila* species have been shown to have relatively high productivity and turnover rates and may be more ecologically important than previously thought. Designation as a threatened species would encourage further study of Johnson's seagrass and would assist FDEP in developing conservation plans. Also, FDEP agreed with NMFS that existing protection for this species was inadequate.

FDEP included the following caveats: First, the presently known geographical locations include several inlets that have regularly experienced maintenance dredging (one since 1948). Yet Johnson's seagrass is still evident around these inlets and in other areas of high human use. It could be argued that maintenance dredging has enhanced this species, or at least not harmed it. Second, the proposed rulemaking states that there is no evidence that commercial, recreational, scientific or educational activities have contributed to the decline of this species. If this species is listed, what more needs to be done to protect it? Third, identification of this species is difficult except by seagrass experts. Those individuals surveying sites need to understand how to clearly identify H. *johnsonii* in the field.

In March 1994, NMFS received additional comments from FDEP concerning the listing proposal, stating that Johnson's seagrass has only recently been recognized as a separate species and that FDEP is seriously concerned with the general lack of knowledge about the organism, especially the many aspects of basic life history. FDEP assumed that the listing of this species as threatened under the ESA should promote the collection of additional knowledge for improved management decisions, including the ability to properly identify the plant in the field.

Other *Halophila* species have been underestimated regarding their importance to nearshore ecosystems, and the FDEP did not want this species to be overlooked if it had a significant role. FDEP recommended that NMFS consider conducting an appropriate research program linked to the listing process and that more must be known

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about the species so that the most appropriate management strategies can be developed. FDEP restated the caveats made in the December 1993, response.

In September 1994, FDEP commented that the steps being taken by NMFS are necessary to adequately protect this species from loss associated with human-related activities. Although FDEP had reservations as to the effects of inlet-related maintenance activities on the continued existence of Johnson's seagrass, it noted that it is clear that direct removal of existing seagrass will be detrimental to the survival of this species. It supported listing the species as a threatened species.

In January 1994 and June 1994, DCA responded to NMFS' request for a coastal zone consistency determination for the designation of critical habitat for Johnson's seagrass. Although DCA referred to both the proposed listing and critical habitat designation in responses to NMFS, the comments from individual state agencies and departments addressed primarily the critical habitat portion. In 1998, DCA wrote, on behalf of the state, that it does not object to the listing of Johnson's seagrass as a threatened species.

**Other Comments**

*Issue* 1: Several commenters questioned whether NMFS has adequate information to determine that Johnson's seagrass should be listed. Others questioned whether it is a separate species rather than a possible mutation or an exotic species not native to the area. Some questioned whether NMFS could list a species without knowing how it reproduces.

One of the peer reviewers, Dr. Susan L. Williams, stated that while there are data gaps for the species and such data should be obtained, it is justifiable to extrapolate from other species in the genus because seagrass congeners are remarkably alike in their ecology. While it is important to clarify the taxonomic status of the species, it is not an issue that needs to be resolved before listing because the morphology of *H. johnsonii* is distinct enough from *H. decipiens* to enable field identification and thus its distribution across habitats. In response to questions on whether *H. johnsonii* is a separate species, another peer reviewer, Dr. Kimon T. Bird, stated that the morphological and flowering characteristics of this species are markedly different from the conspecific species H. *engelmanii* and H. *decipiens*. Recently, H. *johnsonii* was compared to other *Halophila* species from Florida and the Indo-Pacific using isozymes sulfated flavonoids and DNA fingerprinting (Jewett-Smith et al. 1997). Based on these analyses, H. *johnsonii* separates out well from other *Halophila* species in Florida and appears more similar to the narrow leaved forms of the Indo-Pacific based on the use of this DNA analysis.

Regarding the mode of reproduction, Dr. Bird stated that the data provided support the absence of seeds, and he agrees that this species reproduces only by asexual methods. Dr. Williams states that there is concern about the lack of evidence of sexual reproduction since male flowers have not been observed in H. *johnsonii*. Furthermore, the sexual reproduction by seagrasses is poorly understood compared to other angiosperms (e.g. seaweeds), and there have been cases where further studies have revised conclusions on asexuality. Apomixis (vegetative reproduction where normal sexual processes are not functioning or greatly reduced in number) has not been verified in seagrasses.

Nonetheless, considerable field surveys and collections have been conducted on H. *johnsonii* to conclude that if males and/or viable seeds do occur, they are quite rare in the areas studied. Thus, the attributes of potentially limited distribution, rare (if present at all) sexual reproduction, and uncertain vegetative dispersal makes the species prone to disturbance. Dr. Williams also concludes that limited and isolated populations of *H. johnsonii* that rely primarily on vegetative dispersal are probably very prone to local extinction due to

disturbances and stochastic events. The numerous field searches and laboratory transplant culture experiments have indicated the presence of pistillate flowers (no staminate flowers (i.e., only asexual reproduction) over the 16 years since *H. johnsonii* was first described.

*NMFS Response*: The 1996 NMFS sponsored workshop addressed several of these concerns. For example, since additional surveys have not located any male flowers, nor has seedling recruitment been confirmed, the workshop report attributed the distribution and abundance of Johnson's seagrass to a reliance on vegetative means of reproduction and growth. High densities of apical meristems, rapid rates of horizontal growth, and a fast leaf turnover were suggested to explain the appearance and disappearance of *H. johnsonii* observed in disturbed areas and on survey transects. The workshop report suggests that this potential for vegetative expansion, a perennial and intertidal growth habit, and a relatively high tolerance for fluctuating salinity and temperature may enable Johnson's seagrass to colonize and thrive in environments where other seagrasses cannot survive.

Additional molecular genetic information was reviewed in the workshop which supports distinguishing *H. johnsonii* as a separate species from *H. decipien*s, although more detailed and extensive phylogenetic studies were suggested to determine the origin and source of genetic diversity in Johnson's seagrass.

*Issue* 2: Some commenters believe the species is much more abundant in South Florida than the status review indicates and that it occurs in places other than the east coast of Florida (e.g., Bahamas or Florida west coast). Dr. Bird states that he contacted three trained marine botanists along the west coast of Florida. They reported that they had never seen H. *johnsonii* along the west coast. In addition, McMillan made no reference to its presence in Texas when writing the paper describing the new species, even though he is far more familiar with the marine botany of Texas than Florida. While several commenters reported seeing it in the Bahamas, their observations were anecdotal. Based on the information provided, Dr. Bird concurs that *H. johnsonii* is limited to a narrow geographic range along the east coast of Florida.

Dr. Williams states that knowledge of the distribution of H. *johnsonii* throughout the subtropical and tropical Atlantic should be extended, but it should not affect listing the species because in its known distribution, it is vulnerable to disturbances of dredging and reduced water clarity, as are all the co-occurring seagrass species. NMFS Response: In 1986, Robert Virnstein (St. John's River Water Management District) and Kalani Cairns (U.S. Fish and Wildlife Service) mapped a 50–mile section of the Indian River Lagoon from St. Lucie Inlet to Sebastian Inlet. Even though *H. johnsonii* and *H. decipiens* seemed to be proliferating, data did not indicate whether this was a trend or a one-time increase. Also, because both species have short leaves, they may have been overlooked in previous surveys. They stated that 1986 was considered a ''good'' year for seagrasses even though many areas were"stressed" and had lost seagrasses.

Furthermore, they opined that one ''bad'' year could result in the loss of up to half of the present coverage and no one could predict whether such loss would be permanent or that the species would recover.

Virnstein and Morris (1996–personal communication) have said that their 3-year study of 74 seagrass transects in the

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Indian River Lagoon has yielded information on deeper water distributions measuring a few centimeters to more than several hundred meters. These results do not change the distributional limits within the original range of the species.

The report of the NMFS workshop confirms the extremely limited geographic distribution of *H. johnsonii* to patchy and vertically disjunct areas between Sebastian Inlet and northern Biscayne Bay on the east coast of Florida, finding no verifiable sightings outside of the range already reported. This finding is based on new qualitative and quantitative benthic surveys and interviews with scientists.

*Issue* 3: Some commenters remarked that it is difficult to identify Johnson's seagrass in the field and that those reviewing sites need to understand how to clearly identify the species.

*NMFS Response*: Distinct morphological differences allow for both field and laboratory differentiation of the species. H. *johnsonii* is distinct from the conspecific H. *decipiens* in basic leaf characteristics. H. *johnsonii* has elongated linear leaves with complete margins and H. *decipiens* has broad, elliptical (paddle-shaped) leaves with serrated margins. Increased outreach after listing, including recovery planning and section 7 consultations, will improve stakeholders' familiarity with these differences.

*Issue* 4: Some commenters questioned the presence of Johnson's seagrass near inlets that have been routinely dredged for years and in other areas of high human usage. The question is whether certain dredging, especially maintenance dredging, impacts Johnson's seagrass, or whether the species occurs in these areas as a result of dredging.

*NMFS Response*: The effects of maintenance dredging on Johnson's seagrass have not yet been characterized. Johnson's seagrass requires suitable salinity levels, water transparency, and water quality as well as stable, unconsolidated sediments.

These elements are found in shallow waters and shoals around inlets and disturbed areas as well as in undisturbed, more isolated deeper areas of the lagoon. Common factors in

its distribution appear to be its ability to grow in association with other species and its ability to survive in shallow intertidal flats environments typical of the flood tide deltas near inlets. Johnson's seagrass may extend the coverage of seagrasses within lagoons in some of the zones where other grasses do not grow.

Dr. Bird questions the ability of H. *johnsonii* to withstand nearby dredging activities because the sediments of the Indian River contain a good deal of highly organic particulate materials. When resuspended by dredging activities or other physical disturbances, the fine particulate material can attenuate light (reducing Photosynthetically Active Radiation (PAR)) and be a limiting factor in photosynthesis and subsequent seagrass growth and maintenance.

Several scientists working in the area and for the state of Florida stated that it is clear that direct removal of existing seagrass through new construction will be detrimental to the survival of Johnson's seagrass. There have been no reports of healthy populations outside the presently known range. The survival of the species likely depends on maintaining existing viable populations, especially in areas where large patches are found.

*Issue* 5: Some commenters said that seagrasses have overwhelming importance to the ecology and economy of South Florida. Seagrasses are high primary producers within their ecosystem. They provide valuable habitat as nurseries, provide refuge for fisheries, and recycle nutrients throughout their ecosystems. Seagrasses are also a food source for endangered green turtles and the Florida manatee.

When seagrass beds disappear, fishery productivity also decreases. They noted that declines in seagrass beds have been documented worldwide, particularly in the Indian River Lagoon, the primary habitat of *H. johnsonii*.

*NMFS Response*: NMFS agrees that seagrasses play an important role in their ecosystems and provide valuable habitat. The vulnerability of seagrasses in general and *H. johnsonii* in particular, provides the impetus for this listing.

*Issue* 6: Some commenters said that the species should be listed as endangered rather than threatened, and that NMFS underestimated the effects of climate change and increasing development and population growth in Florida.

*NMFS Response*: NMFS believes that only limited information exists regarding Johnson's seagrass, reproductive capacity, life history characteristics (growth rates, environmental requirements), and the effects of human disturbance which would be necessary in determining that Johnson's seagrass is in danger of extinction throughout all or a significant portion of its range. The protection afforded by listing as threatened will result in the subsequent development of a recovery plan for H. *johnsonii*. The recovery plan will address the gaps in our knowledge of the biology and ecology of Johnson's seagrass, and such knowledge will, in turn, lead to a better understanding of the demography and population biology of this species.

Dr. Bird states that although the evidence points to a valid species with a limited distribution, the questions of its degree of extinction is more difficult to resolve. *Halophila* species as a whole appear to be patchy with few species developing extensive stands. However, he agrees with NMFS' conclusions that human activities in the area could impact the species. Existing criteria and standards, as well as enforcement measures, are inadequate to protect seagrasses.

*Issue* 7: Several commenters expressed concern about whether maintenance dredging of existing inlets and channels would be allowed to continue if Johnson's seagrass is listed.

*NMFS Response*: NMFS is concerned about the possibility of losing patches of Johnson's seagrass that may be essential to the genetic viability of the species. However, NMFS expects that maintenance dredging activities will be authorized with the oversight provided by section 7 of the ESA.

*Issue* 8: Several commenters were concerned that the listing of Johnson's seagrass would prevent or severely curtail expansion or development of ports and maintenance of existing ports, channels and inlets. In turn, this would adversely affect the economy in their communities.

*NMFS Response*: The ESA mandates that listing determinations be made solely on the basis of the best scientific and commercial data available after conducting a review of the status of the species and taking into account those conservation efforts being made by any state. However, section 7 of the ESA provides a mechanism for actions requiring Federal funding permits or participation to be conducted in a manner that prevents jeopardy to any species. Therefore, NMFS anticipates that most marine related activities can continue when measures are taken through the section 7 consultation process with Federal agencies to reduce adverse impacts and avoid jeopardizing the continued existence of the species.

*Issue* 9: Some commenters stated that any threats to the habitat could be corrected or were being corrected without the species being listed. For example, problems due to prop scarring could be resolved by marking navigation channels and establishing speed zones. Several counties are installing storm water management systems to improve



water quality. Maintenance dredging is regulated by the state, and spoil is now deposited on beaches to protect shorelines rather than on spoil islands.

*NMFS Response*: Other embayments in the distributional range of

Johnson's seagrass have marked navigational channels, but seagrass bed scarring still occurs. ''Many of the sea-grass beds in the Indian River Lagoon have prop scars resulting from boaters attempting to cross shallow waters and running aground'' (Indian River Lagoon Comprehensive Conservation and Management Plan, May 1996). Erosion caused by damage from boat wakes may also result in turbidity and siltation, which adversely affect seagrass.

*Issue 10*: One commenter wrote that the updated information provided by NMFS reveals that the species is doing well, and shows no signs of decrease in health or population. The commenter also wrote that its geographic range was, if anything, larger than what was reported in 1993.

*NMFS Response*: In order to update the original status report (Kenworthy, 1993) and to include information from new field and laboratory research on species distribution, ecology, use, genetics and phylogeny, NMFS convened a workshop on the biology, distribution, and abundance of *H. johnsonii*. The results of this workshop, held in St. Petersburg, Florida, in November 1996, have been summarized in the workshop proceedings (Kenworthy, 1997) submitted to NMFS on October 15, 1997. The new information confirmed NMFS' original determination that the species should be listed as threatened. This final rule is based on updated information.

*Issue 11*: Some commenters noted that in the proposed rule, NMFS stated that there is no evidence that the overutilization for commercial, recreational, scientific or educational purpose contributed to the decline of Johnson's seagrass. If this listing factor has not contributed to the decline, they questioned what more needs to be done to protect the species.

*NMFS Response*: This factor refers to the actual use of the species itself. For example, if a plant were harvested commercially for food, medicines, or other products, this use might have contributed to the decline of the organism. Johnson's seagrass habitat may be affected by other resource harvesting activities in the ecosystem, but the species itself is not used for commercial, recreational, or educational activities.

*Issue 12*: Several commenters stated that there are adequate Federal and State laws to protect all seagrasses which make the additional protection afforded by the ESA unnecessary.

*NMFS Response*: While it is clear that the intent of Federal and Florida state laws is to conserve and protect seagrass habitat, it is also clear that there is continued and well-documented loss of seagrass habitat in the United States and elsewhere. For example, seagrasses have declined in many areas of the Indian River Lagoon (Virnstein and Morris, 1996). Previous transplantation efforts to mitigate for the loss of seagrass beds have failed. Until recently, *Halophila* species have not been transplanted successfully in the field and studies underway are incomplete (Kenworthy -personal communication). Many seagrass ecosystems are known to recover very slowly even under the most natural, pristine conditions. Current efforts are insufficient to protect critical seagrasses. This was also the conclusion and recommendation of scientists attending the International Seagrass Workshop in Kominato, Japan in August 1993.

NMFS believes that Johnson's seagrass needs the additional protection of listing, including consideration of effects of Federal actions on the species through the section 7 consultation process of the ESA. During consultation with other Federal agencies, NMFS can ensure that any federally funded, permitted, or authorized activity includes adequate measures to reduce adverse impacts from these activities and to prevent jeopardizing the continued existence of the species.

*Issue 13*: One commenter wrote that NMFS had exceeded the time limit for making a final determination after proposing to list Johnson's seagrass as threatened in 1993.

*NMFS Response*: In 1989, NMFS was notified by the FWS that it had received information indicating that *H. johnsonii* was a rare species which may need to be listed under the ESA. By 1993, NMFS had gathered enough information to propose listing the species as threatened. In 1994, NMFS proposed critical habitat for the species. A joint public hearing was held on both the proposed listing and proposed critical habitat. The proposed critical habitat designation was very controversial.

Because of the controversy and new NMFS/FWS polices on listing, NMFS postponed the final listing decision until information used to make the original proposal had been peer reviewed and additional information gathered. Peer review of the original information and the results of new studies confirmed NMFS' original determination that the species should be listed as threatened. The new information was reviewed at a technical workshop in November 1996, and summarized in a report in October 1997. In addition to gathering new information, the final listing was delayed by the year-long Congressionally imposed moratorium on listing species in fiscal year 1996.

**Summary of the Factors Affecting the Species**

After a thorough review and consideration of all information available, NMFS concludes that H. *johnsonii* warrants listing as a threatened species. Procedures found at section 4(a)(1) of the ESA (16 U.S.C. 1531 *et seq.*) and regulations (50 CFR part 424) promulgated to implement the listing provisions of the ESA were followed. A species may be determined to be endangered or threatened due to one or more of the five factors described in section 4(a)(1). These factors and their application to *H. johnsonii* are as follows:

1. Present or Threatened Destruction, Modification or Curtailment of its Habitat or Range.

Habitat within the limited range in which *H. johnsonii* exists is at risk of destruction by a number of human and natural perturbations including (1) dredging; (2) prop scoring; (3) storm surge; (4) altered water quality; and (5) siltation. Due to the fragile nature of *H. johnsonii's* shallow root system, the plants are vulnerable to human-induced disturbances in addition to the major natural disturbances to the sediment, and their potential for recovery may be limited. Destruction of benthic communities due to boating activities (propeller scarring and anchor mooring) was observed at all *H. johnsonii* sites during the NMFS study. Further, this condition is expected to worsen with the predicted increase in boating activity. This severely disrupts the benthic habitat by breaching root systems and severing rhizomes, and significantly reducing the viability of the community.

Turbidity is a critical factor in the distribution and survival of seagrasses, especially in deeper regions of the lagoon, where reduced PAR limits photosynthesis. Shallow regions are less affected by turbidity unless light is rapidly attenuated. In interior lagoonal areas where salinity is low, highly colored water typically is discharged via drainage systems. Stained waters attenuate shorter wavelengths rapidly, removing important PAR as well as potentially stressing plants due to thelow salinity. This is a critical factor, especially in the vicinity of Sebastian,



St. Lucie, Jupiter, and Ft. Pierce Inlets, and Lake Worth and North Biscayne Bay where freshwater reaches the flood tide delta and nearby seagrass meadows via rivers and canal systems that discharge into the lagoon.

Trampling due to human disturbance and increased land-use induced siltation can threaten viability of the species. Degradation of water quality due to human impact is also a threat to the welfare of seagrass communities. Nutrient over-enrichment caused by inorganic and organic nitrogen and phosphorous loading via urban and agricultural land run-off can stimulate increased algal growth that may smother the understory of H. *johnsonii*, shade rooted vegetation, and diminish the oxygen content of the water. Such low oxygen conditions have a demonstrated severe negative impact on seagrasses and associated communities. Continued and increased degradation of environmental quality also will have a detrimental effect upon *H. johnsonii* communities.

2. Overutilization for Commercial, Recreational, Scientific or Educational Purposes.

Overutilization for these purposes has not been a documented factor in the decline of this species.

3. Disease or Predation

There are two known herbivores that occur in the range of *H. johnsonii*—the green sea turtle *(Chelonia mydas*), and the West Indian manatee *(Trichechus manatus*), both of which feed upon the seagrass. Herbivorous fish also feed upon the seagrass community. Predation pressures alone are not likely to be a threat to the species existence.

4. The Inadequacy of Existing Regulatory Mechanisms.

Despite existing Federal and Florida state laws to conserve and protect seagrass habitat, there is a continued and well-documented loss of seagrass habitat in the United States and elsewhere. For example, seagrasses have declined in many areas of the Indian River Lagoon (Virnstein and Morris, 1996). The Florida Department of Natural Resources and the Florida Department of Environmental Regulation have recently merged, greatly increasing the assignment of enforcement responsibilities without an associated increase in staff for the Marine Patrol. Although stormwater management systems are installed or being installed, the Florida Indian River Lagoon Act of 1990 does not cover other large inputs that will affect water quality, which in turn could affect seagrasses (e.g. industrial discharges, brine disposal, canals, processing plants).

Previous transplantation efforts to mitigate for the loss of seagrass beds have failed. Until recently, *Halophila* species have not been transplanted successfully in the field and studies underway are incomplete (Kenworthy - personal communication). Many seagrass ecosystems are known to recover very slowly even under the most natural, pristine conditions. Current efforts are insufficient to protect critical seagrasses. This was also the conclusion and recommendation of scientists attending the International Seagrass Workshop in Kominato, Japan in August 1993.

5. Other Natural or Human-made Factors Affecting Its Continued Existence.

The existence of the species in a very limited range increases the potential for extinction from stochastic events.

Natural disasters such as hurricanes could easily diminish entire populations and a significant percentage of the species. Seagrass beds that are in proximity to inlets are especially vulnerable to storm surge from hurricanes and severe storm events.

**Efforts Being Made To Protect Johnson's Seagrass**

Section 4(b)(1) of the ESA requires the Secretary of Commerce (Secretary) to make listing determinations solely on the basis of the best scientific and commercial data available and after taking into account state efforts being made to protect the species. Therefore, in making its listing determinations, NMFS assesses the status of the species, identifies factors that have led to the decline of the species, and assesses available conservation measures to determine whether such measures ameliorate risks to the species.

There is a continued and well-documented loss of seagrass habitat notwithstanding existing Federal and state laws to

conserve and protect this habitat. Previous transplantation efforts to mitigate for the loss of seagrass beds have failed. NMFS has determined that these existing conservation efforts are not sufficient to prevent a listing determination. NMFS will, however, consider state conservation efforts when developing protective regulations under section 4(d) of the ESA. State conservation efforts may also serve as a basis for a cooperative agreement under section 6 of the ESA.

**Listing Determination**

Based on available information, NMFS concludes that Johnson's seagrass warrants listing as a threatened species. This species is rare, has a limited reproductive capacity, and is vulnerable to a number of anthropogenic or natural disturbances. Also, it exhibits one of the most limited distributions of any seagrass. Within its limited range (lagoons on the east coast of Florida from Sebastian Inlet to central BiscayneBay), it is one of the least abundant species. Because of its limited reproductive capacity and limited energy storage capacity, it is less likely to survive environmental perturbations and to be able to repopulate an area when lost. Finally, habitat loss has continued despite existing Federal and state conservation efforts.

**Conservation Measures**

Conservation measures provided to species listed as endangered or threatened under the ESA include recognition, recovery action, requirements for Federal protection, and prohibitions against certain activities.

Recognition through listing encourages and results in conservation actions by Federal, State, and local agencies, private organizations, and individuals. The ESA provides for cooperation with states and requires that recovery actions be carried out for all listed species. The protection required of Federal agencies and the prohibitions against certain activities involving listed plants are discussed, in part, here.

Section 9 of the ESA prohibits certain activities that directly or indirectly affect endangered species. These prohibitions apply to all individuals, organizations, and agencies subject to U.S. jurisdiction. Section 9 prohibitions apply automatically to endangered species; as described below, this is not the case for threatened species.

Section 4(d) of the ESA directs the Secretary to implement regulations ''to provide for the conservation of [threatened] species'' that may include extending any or all of the prohibitions of section 9 to threatened species.

Section 9(a)(2)(E) also prohibits violations of protective regulations for threatened species of plants implemented under section 4(d). While NMFS proposed extending the section 9 prohibitions to Johnson's seagrass, it is not including that proposal in this final rule. Rather, NMFS will issue protective regulations pursuant to section 4(d) for Johnson's seagrass in a separate proposed rulemaking.

Section 7 (a)(4) of the ESA requires Federal agencies to consult with NMFS on any action that is likely to jeopardize the continued existence of a species proposed for listing or result in destruction or adverse modification of proposed critical habitat. For listed species, section 7 (a)(2) requires Federal agencies to ensure that activities they

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authorize, fund, or carry out are not likely to jeopardize the continued existence of such a species or to destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, theresponsible Federal agency must enter into formal consultation with NMFS.

Federal agency actions or programs that may affect populations of Johnson's seagrass and its habitat include U.S. Army Corps of Engineers authorization of projects affecting waters of the U.S. under section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act (i.e., beach nourishment, dredging, and related activities including the construction of docks and marinas); Environmental Protection Agency authorization of pollutant discharges and management of freshwater discharges into waterways; U.S. Coast Guard regulation of vessel traffic; management of national refuges and protected species by the FWS; management of vessel traffic and other activities by the U.S. Navy;

authorization of state coastal zone management plans by NOAA's National Ocean Service, and management of commercial fishing and protected species by NMFS.

Listing H. johnsonii as threatened provides for the development of a recovery plan for the taxon. The recovery plan would establish a framework for State and Federal agencies to coordinate activities and to cooperate with each other in conservation efforts. The plan would set recovery priorities and describe site-specific management actions necessary to achieve the conservation of Johnson's seagrass.

**Critical Habitat**

Section 4(b)(6)(C) of the ESA requires that, to the extent prudent, critical habitat be designated concurrently with the listing of a species unless such critical habitat is not determinable at that time. As stated previously, NMFS proposed a designation of critical habitat on August 4, 1994 (59 FR 39716). Given the passage of time since that proposal, NMFS will address the designation of critical habitat in a separate **Federal Register** notice and additional comments will be solicited at that time.

**References**

A complete list of all references cited herein is available upon request (see **ADDRESSE**S).

**Classification**

The 1982 Amendments to the ESA, in section 4(b)(1)(A),

restrict the information that must be considered when assessing species for listing. Based on this limitation of criteria for a listing decision and the opinion in *Pacific Legal Foundation* v. *Andrus*, 657 F.2d 829 (6th Cir. 1981), NMFS has categorically excluded all ESA listing actions from environmental assessment requirements of the National Environmental Policy Act (NEPA) under NOAA Administrative Order 216–6.

As noted in the Conference report on the 1982 amendments to the ESA, economic impacts cannot be considered when assessing the status of the species. Therefore, the economic analysis requirements of the Regulatory Flexibility Act (RFA) are not applicable to the listing process. In addition, this final rule is exempt from review under E.O. 12866.

At this time NMFS is not issuing protective regulations under section 4(d) of the ESA. In the future, prior to finalizing its 4(d) regulations for this species, NMFS will comply with all relevant NEPA and RFA requirements.

This final rule does not contain a collection-of-information requirement subject to the Paperwork Reduction Act.

**List of Subjects in 50 CFR Part 227**

Endangered and threatened species, Exports, Imports, Marine Mammals, Transportation.

Dated: August 27, 1998.

**Hilda Diaz-Soltero,**

*Acting Assistant Administrator for Fisheries, National Marine Fisheries Service.*

For the reasons set forth in the preamble, 50 CFR part 227 is amended as follows:

**PART 227—-THREATENED SPECIES**

1. The authority citation for part 227 reads as follows:

**Authority:** 16 U.S.C. 1531–1543; subpart B, 227.12 also issued under 16 U.S.C., 1361 *et seq*.

2. The heading for part 227 is revised to read as set forth above.

3. Section 227.4 is amended by adding paragraph (p) to read as follows:

**§ 227.4 Enumeration of threatened species.**

* * * * *

(p) Johnson's seagrass *(Halophila johnsonii)*

[FR Doc. 98–24357 Filed 9–11–98; 8:45 am]

**BILLING CODE 3510–22–F**

**APPENDIX II**

**Notice for Critical Habitat for *Halophila johnsonii***
**Federal Register 65(66): 17786**

**DEPARTMENT OF COMMERCE**
**National Oceanic and Atmospheric Administration**
50 CFR Part 226
[Docket No. 991116305–0083–02; I.D. No.
110599D][A]
RIN 0648–AL82
Designated Critical Habitat: Critical Habitat for Johnson's Seagrass
AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.
**ACTION:** Final rule.
**SUMMARY:** NMFS is designating critical habitat for Johnson's seagrass *(Halophila johnsonii)* pursuant to section 4 of the Endangered Species Act (ESA).
Johnson's seagrass is found on the east coast of Florida from Sebastian Inlet to central Biscayne Bay. Within this range, 10 areas are being designated as critical habitat: a portion of the Indian River Lagoon, north of the Sebastian Inlet Channel; a portion of the Indian River Lagoon, south of the Sebastian Inlet Channel; a portion of the Indian River Lagoon near the Fort Pierce Inlet; a portion of the Indian River Lagoon, north of the St. Lucie Inlet; a portion of Hobe Sound; a site on the south side of Jupiter Inlet; a site in central Lake Worth Lagoon; a site in Lake Worth Lagoon, Boynton Beach; a site in Lake Wyman, Boca Raton; and a portion of Biscayne Bay. NMFS is modifying various aspects of the proposed rule, including the removal as critical habitat of the Intracoastal Waterway (ICW) channel in the designated areas, and enlarging the Lake Wyman site.
The designation of critical habitat provides explicit notice to Federal agencies and the public that these areas and features are vital to the conservation of the species.
**DATES:** This rule is effective May 5, 2000.
**FOR FURTHER INFORMATION CONTACT:**
Layne Bolen, NMFS, Southeast Region, 850–234–6541 ext 237, or Marta Nammack, NMFS, Office of Protected Resources, 301-713-1401.
**SUPPLEMENTARY INFORMATION:**
**Background**
NMFS published a proposed rule to list Johnson's seagrass as a threatened species on September 15, 1993 (58 FR 48326), and a proposed rule to designate critical habitat on August 4, 1994 (59 FR 39716). A public hearing on both the proposed listing and critical habitat designation was held in Vero Beach, Florida, on September 20, 1994. As a result of public input during the comment period, NMFS postponed further action on listing. In order to update the original status report (Kenworthy, 1993) and to include information from new field and laboratory research on species distribution, ecology, genetics and phylogeny, NMFS convened a workshop on the biology, distribution, and abundance of H. *johnsonii*. The results of this workshop were summarized in the proceedings (Kenworthy, 1997) submitted to NMFS on October 15, 1997. NMFS reopened the comment period for the proposed listing on April 20, 1998 (63 FR 19468). The final rule to list Johnson's seagrass as a threatened



species was published by NMFS on September 14, 1998 (63 FR 49035). Section 4(a)(3)(A) of the ESA requires that, to the maximum extent prudent and determinable, NMFS designate critical habitat concurrently with a determination that a species is endangered or threatened. At the time of final listing, critical habitat was not determinable because new information needed to perform the required analysis was not yet available. On February 23, 1999, NMFS established and convened a recovery team to prepare a recovery plan and develop recommendations for critical habitat for Johnson's seagrass. Based on these recommendations and the best available scientific data on the distribution, ecology, and genetics of this species, NMFS published a re-proposed rule on December 2, 1999 (64 FR 67536), to designate critical habitat for Johnson's seagrass. This final rule takes into consideration the new information and comments received in response to this re-proposed rule.
The final designation identifies those physical and biological features of the habitat that are essential to the conservation of the species and that may require special management consideration or protection. The economic and other impacts resulting from designating critical habitat, over and above those that result from listing the species, are expected to be minimal. The use of the term ''essential habitat'' within this document refers to critical habitat as defined by the ESA and should not be confused with the requirement to describe and identify Essential Fish Habitat pursuant to the Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. 1801 et seq.
**Definition of Critical Habitat**
Critical habitat is defined in section 3(5)(A) of the ESA as ''(i) the specific areas within the geographical area occupied by the species...on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species...upon a determination by the Secretary of Commerce (Secretary) that such areas are essential for the conservation of the species.'' The term ''conservation'' as defined in section 3(3) of the ESA, means ''...to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary.''
In designating critical habitat, NMFS must consider the requirements of the species, including: (1) space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for breeding, reproduction, or rearing of offspring; and, generally, (5) habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of the species (50 CFR 424.12(b)).
In addition, NMFS must focus on and list the known physical and biological features (primary constituent elements) within the designated area(s) that are essential to the conservation of the species and that may require special management considerations or protection. These essential features may include, but are not limited to, food resources, water quality or quantity, and vegetation and sediment types and stability (50 CFR 424.12(b)).
**Benefits of Designating Critical Habitat**
The designation of critical habitat does not, in itself, restrict state or private activities within the area or mandate any specific management or recovery actions. A critical habitat designation contributes to species conservation primarily by identifying important areas and describing the features within those areas that are essential to the species, thus alerting public and private entities to the importance of the area. Under the ESA, the only regulatory impact of a critical habitat designation is through the provisions of ESA section 7. Section 7 applies only to actions with Federal involvement (e.g., authorized, funded, or conducted by a Federal agency) and does not affect exclusively state or private activities.
Under the ESA section 7 provisions, a designation of critical habitat would require Federal agencies to ensure that any action they authorize, fund, or carry out is not likely to destroy or adversely

modify the designated critical habitat. Activities that destroy or adversely modify critical habitat are defined as those actions that ''appreciably diminish the value of critical habitat for both the survival and recovery'' of the species (50 CFR 402.02). Regardless of a critical habitat designation, Federal agencies must ensure that their actions are not likely to jeopardize the continued existence of the listed species. Activities that jeopardize a species are defined as those actions that ''reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery'' of the species (50 CFR 402.02). Using these definitions, in most cases activities that are likely to destroy or adversely modify critical habitat would also be likely to jeopardize the species. Therefore, in most cases the protection provided by a critical habitat designation generally duplicates the protection provided under the section 7 jeopardy provision. Critical habitat may provide additional benefits to a species in cases where areas outside of the species' current range have been designated. In these cases, Federal agencies are required to consult with NMFS under section 7 (50 CFR 402.14 (a)) when these designated areas may be affected by their actions. The effects of these actions on designated areas may not have been recognized but for the critical habitat designation.

A designation of critical habitat provides Federal agencies with a clearer indication as to when consultation under section 7 of the ESA is required, particularly in cases where the action would not result in direct mortality, injury, or harm to individuals of a listed species (e.g., an action occurring within the critical habitat area when or where Johnson's seagrass is not present). The critical habitat designation, in describing the essential features of the habitat, also helps determine which activities conducted outside the designated area are subject to ESA section 7 (i.e., activities that may affect essential features of the designated area). For example, disposal of waste material in water adjacent to a critical habitat area may affect an essential feature of the designated habitat (water quality) and would be subject to the provisions of section 7 of the ESA.

A critical habitat designation also assists Federal agencies in planning future actions because the designation establishes, in advance, those habitats that will be given special consideration in ESA section 7 consultations. This is particularly true in cases where there are alternative areas that would provide for the conservation of the species and the success of the action. With a designation of critical habitat, potential conflicts between Federal actions and endangered or threatened species can be identified and possibly avoided early in the agency's planning process.

Another indirect benefit of designating critical habitat is that it helps focus Federal, state and private conservation and management efforts in those areas. Recovery efforts may address special considerations needed in critical habitat areas, including



conservation regulations that restrict private as well as Federal activities. No additional conservation regulations are associated with this critical habitat designation, however. Any future proposal would require a full, separate rulemaking. Other Federal, state and local laws or regulations, such as zoning or wetlands protection, may also provide special protection for critical habitat areas.

**Consideration of Economic and Other Factors**

The economic, environmental, and other impacts of a designation must also be evaluated and considered. NMFS must identify present and future activities that may adversely modify designated critical habitat or be affected by a designation. An area may be excluded from a critical habitat designation if NMFS determines that the overall benefits of exclusion outweigh the benefits of designation, unless the exclusion will result in the extinction of the species (16 U.S.C. 1533(b)(2)).

The impacts considered in this analysis are only those incremental impacts that specifically result from designating critical habitat above the economic and other impacts attributable to listing the species or resulting from other authorities. These incremental impacts are expected to be minimal (see Benefits of Designating Critical Habitat section). In general, the designation of critical habitat highlights geographical areas of concern and reinforces the substantive protection resulting from the listing itself.

Section 9 of the ESA prohibits certain activities that directly or indirectly affect endangered species. These prohibitions apply to all persons and entities subject to U.S. jurisdiction. Section 9 prohibitions apply automatically to endangered species; however, this is not the case for threatened species. Section 4(d) of the ESA directs the Secretary to implement regulations ''to provide for the conservation of [threatened] species'' that may include extending any or all of the prohibitions of section 9(a)(2) to threatened species. Section 9(a)(2)(E) of the ESA also prohibits violations of protective regulations for threatened species of plants implemented under section 4(d). NMFS may issue protective regulations pursuant to section 4(d) for Johnson's seagrass in a future rulemaking.

Impacts attributable to listing also include those resulting from the responsibility of all Federal agencies under section 7 of the ESA to ensure that their actions are not likely to jeopardize endangered or threatened species. An action could be likely to jeopardize the continued existence of a listed species through the destruction or adverse modification of its habitat, whether or not that habitat has been designated as critical.

**Need for Special Management Consideration or Protection**

NMFS has determined that the essential areas and features described here are at risk and may require special management consideration or protection. Special management may be required because of the following activities: (1) Vessel traffic and the resulting propeller dredging and anchor mooring; (2) dredging; (3) dock, marina, and bridge construction and shading from these structures; (4) water pollution; and (5) land use practices including shoreline development, agriculture, and aquaculture. Activities associated with recreational boat traffic account for the majority of human use associated with the critical habitat areas. The destruction of the benthic community due to boating activities, propeller dredging, anchor mooring, and dock and marina construction was observed at all sites during a study by NMFS from 1990 to 1992. These activities severely disrupt the benthic habitat, breaching root systems, severing rhizomes, and significantly reducing the viability of the seagrass community. Propeller dredging and anchor mooring in shallow areas are a major disturbance to even the most robust seagrasses. This destruction is expected to worsen with the predicted increase in boating activity. Trampling of seagrass beds, a secondary effect of recreational boating, also disturbs seagrass habitat.

Populations of Johnson's seagrass inhabiting shallow water and water close to inlets, where vessel traffic is concentrated, will be most affected. The constant sedimentation patterns in and around inlets require frequent maintenance dredging, which could either directly remove essential seagrass habitat or indirectly affect it by redistributing sediments, burying plants and destabilizing the bottom structure. Altering benthic topography or burying the plants may remove them from the

photic zone.
Permitted dredging of channels, basins, and other in-and on-water construction projects cause loss of Johnson's seagrass and its habitat through direct removal of the plant, fragmentation of habitat, and shading. Docking facilities that, upon meeting certain provisions, are exempt from state permitting also contribute to loss of Johnson's seagrass through construction impacts and shading. Fixed add-ons to exempt docks (such as finger piers, floating docks, or boat lifts) have recently been documented as an additional source of seagrass loss due to shading (Smith and Mezich, 1999). Decreased water transparency caused by suspended sediments, water color, and chlorophylls could have significant detrimental effects on the distribution and abundance of the deeper water populations of Johnson's seagrass. A distribution survey in Hobe and Jupiter Sounds indicates that the abundance of this seagrass diminishes in the more turbid interior portion of the lagoon where reduced light limits photosynthesis.
Other areas of concern include seagrass beds located in proximity to rivers and canal mouths where low salinity, highly colored water is discharged. Freshwater discharge into areas adjacent to seagrass beds may provoke physiological stress upon the plants by reducing the salinity levels. Additionally, colored waters released into these areas reduce the amount of sunlight available for photosynthesis by rapidly attenuating shorter wavelengths of Photosynthetically Active Radiation. Also, continuing and increasing degradation of water quality due to increased land use and water management threatens the welfare of seagrass communities. Nutrient over-enrichment
caused by inorganic and organic nitrogen and phosphorous loading via urban and agricultural land run-off stimulate increased algal growth that may smother Johnson's seagrass, shade rooted vegetation, and diminish the oxygen content of the water. Low oxygen conditions have a demonstrated negative impact on seagrasses and associated communities.
Special consideration and protection for these and other habitat features are evaluated in the ESA section 7 consultation process. Special management needs and the protection of these habitat features are being addressed in the development and implementation of the recovery plan.

**Activities That May Affect Critical Habitat**

A wide range of activities funded, authorized or carried out by Federal agencies may affect the essential habitat requirements of Johnson's seagrass. These include authorization by the COE for beach nourishment, dredging, and related activities including construction of docks and marinas; bridge construction projects funded by the Federal Highway Administration; actions by the U.S. Environmental Protection Agency and the COE to manage freshwater discharges into



waterways; regulation of vessel traffic by the U.S. Coast Guard (USCG); management of national refuges and protected species by the U.S. Fish and Wildlife Service; management of vessel traffic (and other activities) by the U.S. Navy; approval of changes to Florida's coastal zone management plan by NOAA's National Ocean Service; and management of commercial fishing and protected species by NMFS.

**Expected Impacts of Designating Critical Habitat**

This designation will identify specific habitat areas that have been determined to be essential for the conservation of Johnson's seagrass and that may be in need of special management considerations or protection. It will require Federal agencies to evaluate their activities with respect to the critical habitat of this species and to consult with NMFS pursuant to section 7 of the ESA before engaging in any action that may affect the critical habitat.
As discussed in the section on activities that may impact essential habitat and features, the Federal activities that may affect critical habitat are the same activities that may affect the species itself. For plants, this is particularly true when analyzing the impacts of designating critical habitat. For example, the activities that affect water quality, an essential feature of critical habitat, will also be considered in terms of how they affect the species itself.
Federal agencies will continue to engage in ESA section 7 consultations to determine if the actions they authorize, fund or carry out are likely to jeopardize the continued existence of Johnson's seagrass; however, with designation, they would also need to address explicitly impacts to the species' critical habitat. This is not expected to affect materially the scope of future consultations or result in greater economic impacts, since most impacts to Johnson's seagrass habitat will already be considered in ESA section 7 consultations.
The economic costs to be considered in a critical habitat designation are the incremental costs of designation above the economic impacts attributable to listing or attributable to authorities other than the ESA. NMFS has determined that there are few, if any, incremental net costs for areas within the species' current distribution, and no areas outside the current range are being designated as critical habitat.

**Critical Habitat of Johnson's Seagrass**

The biology of Johnson's seagrass is discussed in the final rule to list the species as threatened (63 FR 49035, September 14, 1998) and includes information on the current status of the species, its life history characteristics and habitat requirements, as well as projects, activities and other factors affecting the species. The physical habitat that supports Johnson's seagrass includes both shallow intertidal and deeper subtidal zones. The species prospers and is able to colonize and maintain stable populations either in water that is clear and deep (2-5 m) or in water that is shallow and turbid. In tidal channels, it inhabits coarse sand substrates.
Based on published reports and discussions with seagrass experts, the distributional range of Johnson's seagrass is limited to the east coast of Florida from central Biscayne Bay (25 45' N. lat.) to Sebastian Inlet (27 51' N. lat.). There have been no reports of healthy populations of this species outside the presently known range. Although the species occurs throughout the Indian River Lagoon and Lake Worth, the designated critical habitat areas encompass the largest known contiguous populations of Johnson's seagrass, those areas known to have persistent populations, those populations known to have persistent flowering, those populations found to have unique genetic variability, and/or populations that include the northern and southern limits of the species' range.
The species is distributed in patches within its range. The dimensions of patches range from a few square centimeters to approximately 327 square meters (sq.m). The survival of the species likely depends on maintaining its existing viable populations, especially the areas where the larger patches are found. The Sebastian Inlet population is believed to be the northern limit of its distribution and includes flowering patches that have a known persistence of at least 10 years. Ft. Pierce Inlet and Jupiter Inlet are also found to have persistent and flowering populations. The other designated critical habitat areas represent the core range of the species where Johnson's seagrass is found to be abundant

compared to other parts of its range, exhibits unique genetic make-up, or comprises the southern limit of its range.

Spread of the species into new areas is limited by its reproductive potential. Johnson's seagrass possesses only female flowers; thus vegetative propagation, most likely through asexual branching, appears to be its only means of reproduction and dispersal. If an established community is disturbed, regrowth and reestablishment are extremely unlikely. If extirpated from an area, it is doubtful that the species would be capable of repopulation. This species' method of reproduction impedes the ability to increase distribution as establishment of new vegetation requires considerable stability in environmental conditions and protection from human-induced disturbances.

Based on the best available information, general physical and biological features of the critical habitat areas include adequate water quality, salinity levels, water transparency, and stable, unconsolidated sediments that are free from physical disturbance. The specific areas occupied by Johnson's seagrass are those with one or more of the following criteria: (1) Locations with populations that have persisted for 10 years; (2) locations with persistent flowering populations; (3) locations at the northern and southern range limits of the species; (4) locations with unique genetic diversity; and (5) locations with a documented high abundance of Johnson's seagrass compared to other areas in the species' range. Explanations for these criteria are:

1. *Persistent populations*. Surveys of H. *johnsonii* distribution and abundance in the Indian River Lagoon indicate that populations fluctuate dramatically. In some areas populations disappear and re-appear on both intra- and inter-annual time scales (Virnstein *et al.*, 1997). Some populations have disappeared and not returned. Since sexual reproduction and seed dispersal are unknown, this species may rely on vegetative fragmentation for recruitment and establishment of new populations. Recruitment from fragmentation and migration are random processes which do not guarantee the persistence of the species in any one location. Perennial populations which have persisted for 10 years exist in several locations, including Sebastian Inlet, Fort Pierce Inlet, Jupiter Inlet, and Hobe Sound. Environmental characteristics of these sites appear favorable to the species, while in other locations in the lagoon, populations have disappeared. Locations where populations have persisted have been designated as critical habitat.

2. *Persistent flowering populations*. The existence of male flowers or recruitment by seed have not been documented for H. *johnsonii*. These observations suggest that this species does not reproduce sexually, and if it

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does, it is a very rare event. Yet, large clones of mature female plants flower prolifically at several locations, including Sebastian Inlet, Fort Pierce Inlet, Jupiter Inlet, and Lake Worth Lagoon. The environmental conditions at these sites appear to be suitable for flowering, and if there are any males present, these would be likely habitats for successful reproduction. Locations where there are persistent flowering populations have received critical habitat designation.

3. *Northern and southern ranges of the population*. The geographical limits of the distributional range of a species can indicate a reduction or expansion of the species' range. Greater adaptative stresses can occur at the limits of the species' range. If the range extension were shrinking, the edges should be protected to prevent further loss. In the alternative, the distribution limits may be a point where the populations are expanding and invading new environments. The unique phenotypic and genotypic characteristics of these populations could be an important reservoir for characteristics resistant to extinction and conducive to survival and growth. The northern and southern ranges of Johnson's seagrass are defined as Sebastian Inlet and central Biscayne Bay, respectively. Portions of these limits to the species' range have been designated as critical habitat for Johnson's seagrass.

4. *Populations with unique genetic variability*. The Boca Raton and Boynton Beach sites have populations which are distinguished by a higher index of genetic variation than any of the central and northern populations examined to date. These two sites possibly represent a genetically semi-isolated group which could be the reservoir of a large part of the overall genetic variation found in this species. Information is lacking on the geographic extent of this genetic variability. Locations with populations that have unique genetic variability have been designated as critical habitat.

5. *Areas of abundance*. The Lake Worth Lagoon and Palm Beach County seagrass populations represent an abundant core of *Halophila* species, including Johnson's seagrass. Previously a freshwater lake, Lake Worth was transformed into a lagoon beginning in 1877 when an ocean inlet was stabilized. With dredging of the ICW, shoreline development, and sewage disposal, the lagoon was permanently altered. Presently, there are about 2000 acres of seagrass in the lagoon covering 35 percent of the bottom. It is estimated that between 20 and 25 percent of the seagrass coverage is comprised of mixed assemblages of H. *decipiens* and H. *johnsonii*. This is proportionately more *Halophila* coverage than occurs elsewhere along the southeast coast of Florida. Presently, conditions within Lake Worth Lagoon and in Palm Beach County in general appear to be conducive to the survival of H. *johnsonii*. Three locations within Lake Worth Lagoon have been designated as critical habitat. The critical habitat area in Lake Worth Lagoon, near Bingham Island, consists of the largest recorded contiguous patch of Johnson's seagrass: a 30-acre meadow of Johnson's seagrass intermixed with sparse coverage of H. *decipiens* and *Halodule wrightii* (Smith and Mezich, 1991 and 1999).

NMFS is not including in the final designation any areas outside the species' currently known geographical range. NMFS has concluded that, at this time, proper management of the essential features of the areas around Sebastian and Ft. Pierce Inlet, Hobe Sound, Jupiter Inlet, Lake Worth, Boca Raton, and northern Biscayne Bay will be sufficient to provide for the survival and recovery of this species. NMFS may reconsider this evaluation and propose additional areas for critical habitat at any time. Johnson's seagrass occurs in numerous locations throughout its range in areas outside of those currently being designated as critical habitat. Information on genetic variability and persistence of Johnson's seagrass is currently lacking in these areas. Future research, however, involving genetic studies and comprehensive, long-term field surveys, could identify additional areas that are essential to the conservation of the species and require special management considerations, and would, therefore, warrant designation as critical habitat. Long-term surveys of the distribution of Johnson's seagrass may allow further refinement of the Biscayne Bay critical habitat area in the future. Additional areas that may be considered for critical habitat in future rulemaking include locations between Ft. Pierce Inlet and St. Lucie Inlet, west of the Jupiter Inlet, near the Boynton Beach Inlet and other areas of Lake Worth Lagoon. Also, if a male flower of Johnson's seagrass is identified in an area, this area should be designated as critical habitat.

The regulatory description of critical habitat for Johnson's seagrass can be

found at the end of this **Federal Register** document.

**Summary of Responses**

Two public hearings were held on the proposed action: one in West Palm Beach, Florida, on December 16, 1999, and one in Miami, Florida, on January 31, 2000. Thirty-seven individuals provided oral testimony at the public hearings. Forty-nine comments were submitted in response to the proposed rule. Many comments were in support of designating critical habitat for Johnson's seagrass. However, the majority of comments were concerned about economic impacts from the designation. New information and comments received in response to the proposed rule are summarized here.

*1. Economic Considerations*

Many commenters believed that critical habitat designation would create a substantial economic burden that could delay projects and possibly prohibit certain activities, including recreational boating. The COE commented that critical habitat would place an unnecessary significance to these areas and an additional coordination and consultation burden that would be costly both in terms of the project delay and the cost directly associated with the consultation.

Additional commenters believed that the designation would impose additional requirements or economic impacts upon small and/or private entities beyond those which may accrue from section 7 of the ESA.

*Response*: The designation of critical habitat highlights geographical areas of concern and reinforces the substantive protection resulting from the listing itself. Incremental costs are expected to be no greater than those which occurred at the time of listing (See Consideration of Economic and Other Factors).

ESA section 7 applies only to Federal actions and requires Federal agencies to ensure that any action they carry out, authorize, or fund is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of habitat determined to be critical. The consultation requirements of section 7 are non-discretionary and are effective at the time of species' listing. Therefore, Federal agencies must consult with NMFS to ensure their actions do not jeopardize a listed species, regardless of whether critical habitat is designated. Most of the effect on non-Federal interests will result from the no-jeopardy requirement of section 7 of the ESA, which is a function of listing a species, not designating its critical habitat. Whether or not critical habitat is designated, non-Federal interests must conduct their actions in a manner consistent with the requirements of the ESA. If the activity is funded, permitted, or authorized by a Federal agency, that agency must comply with the non-jeopardy mandate of section 7 of the ESA, which results from listing a



species, not from designating its critical habitat. Once critical habitat is designated, the agency must avoid actions that destroy or adversely modify that critical habitat. However, pursuant to NMFS' ESA implementing regulations, in most cases any action that destroys or adversely modifies critical habitat is also likely to jeopardize the continued existence of the species (See the definitions in 50 CFR 402.02). Therefore, NMFS does not anticipate that the designation will result in significant additional requirements for non-Federal interests. Notwithstanding its lack of economic impact, the designation of critical habitat remains important because it identifies habitat that is essential for the continued existence of a species and, therefore, indicates habitat that may require special management attention. This facilitates and enhances Federal agencies' ability to comply with section 7 of the ESA by ensuring that they are aware when their activities may affect listed species and habitats essential to support them. In addition to aiding Federal agencies in determining when consultations are required pursuant to section 7(a)(2) of the ESA, critical habitat can aid an agency in fulfilling its broader obligation under section 7(a)(1) to use its authority to carry out programs for the conservation of listed species.

On September 1, 1998, NMFS completed a conference opinion (CO) with the U.S. Army Corps of Engineers (COE) on maintenance dredging which concluded that normal maintenance dredging activities and routine operations on ports are not likely to jeopardize the continued existence of Johnson's seagrass or adversely modify proposed critical habitat. If requested by the COE, NMFS will review the CO, and, if no significant changes have occurred in the action as planned or in the information used during the conference, NMFS will confirm the CO as the biological opinion on the project and no further section 7 consultation will be necessary. NMFS expects that maintenance dredging will not be negatively impacted by this final critical habitat designation.

*2. Permitting Delays*

Various commenters voiced concern that dredging projects, including maintenance dredging, would be impaired and possibly prohibited in these areas. Concerns were that the designation would: (a) disrupt the COE permitting process and result in major permitting delays from the section 7 consultation process; (b) impair Palm Beach Harbor expansion projects and Lake Worth Lagoon clean-up efforts; (c) prevent or slow down and make more costly, a dredging project to remove contaminated sediments of the Miami River; (d) essentially stop the maintenance dredging of inlets, the ICW, and many private marina facilities; and (e) further delay and possibly impede FDOT bridge construction and other projects due to the section 7 process.

*Response*: NMFS expects that normal maintenance dredging activities and routine operations on ports will not be negatively impacted by this critical habitat designation. The COE has already conferred with NMFS on the proposed designation for maintenance dredging. Furthermore, there are fewer delays in permitting because the Federal agency knows in the planning process where designated critical habitat areas are for the species (See Benefits of Designating Critical Habitat). The critical habitat areas account for approximately 7 percent of the entire range of the species, and the designation assists Federal agencies (or those delegated to represent Federal lead agencies) in planning future actions because the designation establishes, in advance, those habitats that will be given special consideration in ESA section 7 consultations. Individual permits issued by the COE are being dealt with through the ESA section 7 process and in review by the COE's Nationwide Permit process. These projects will be examined programmatically by waterbody and/or project type.

As noted earlier, excluding an area from critical habitat does not exclude it from consultation under ESA section 7, based on expected impacts to the species. The species has been listed since September 1998, and Federal agencies have been required to confer on impacts to this species since it was proposed for listing in 1994. The designation would not impair or prohibit the timely and economical maintenance of the ICW or other federally-funded projects. The requirement for a Federal action agency to consult on actions which may affect a listed species occurs at the time the species is listed.

*3. Stop or Prohibit Projects/Activities*

Many commenters believed that the outcome of critical habitat designation and the intention of NMFS is to stop or

prohibit projects or activities. One commenter believed that NMFS seeks to ''kill the public's recreational use of Biscayne Bay.''

*Response*: The designation of critical habitat does not, in and of itself, restrict human activities within an area or mandate any specific management or recovery action. The designation of critical habitat helps alert public and private entities to the area's importance, and under section 7 provisions, a critical habitat designation requires Federal agencies to ensure that any action they authorize, fund, or carry out is not likely to adversely modify or destroy critical habitat. The designation assists agencies in planning future actions. It is not the intention of NMFS to prohibit boating or other activities in the range of Johnson's seagrass.

The designation of critical habitat allows for early consultation and development of project alternatives. The Section ''Need For Special Management Considerations'' provides an overview of recognized impacts or threats to the species and its primary constituent elements (such as water quality and substrate stability) that may require special management considerations. Special consideration and protection for these and other habitat features are evaluated in the ESA section 7 consultation process. Special management needs and the protection of these habitat features are being addressed in the development and implementation of the recovery plan.

*4. Intracoastal Waterway and Maintenance Dredging*

This is a subset of the concerns raised earlier. A number of commenters felt that the inclusion of the channel of the ICW was unnecessary for the conservation of the species and an economic burden to maintenance dredging of the waterway and that it would impair and probably prohibit the proper maintenance of the ICW. Similar comments were that the proposed designation would potentially decrease or possibly eliminate maintenance dredging of the ICW in Martin County, substantially impacting public safety and Martin County's economy, and that loss of ICW maintenance dredging may include total prohibition of boating activity within the critical habitat limits.

*Response*: After re-evaluation of the information, feedback from Recovery Team members with expertise in the distribution, abundance and habitat needs for the species, and public input, NMFS has determined that the (approximately 18.5 km) Federally marked navigation channel of the ICW occurring in the critical habitat areas will be excluded from critical habitat designation. NMFS has determined that the exclusion of the channel of the ICW is possible while still allowing for conservation of the species. The exclusion of the ICW channel occurs in



the following critical habitat areas: (1) An interior portion of the Indian River Lagoon, north of the St. Lucie Inlet; (2) Hobe Sound; (3) the site in central Lake Worth Lagoon near Bingham Island; (4) a site in Lake Worth Lagoon, Boynton Beach; (5) a site in Lake Wyman, Boca Raton; and (6) a portion of Biscayne Bay Aquatic Preserve.

As stated earlier, the COE requested formal conference with NMFS when the species was proposed for listing in order to address and plan for the maintenance dredging projects. The NMFS' CO, issued September 1, 1998, concluded that the maintenance dredging of the ICW and ports in the range of Johnson's seagrass is not likely to jeopardize the continued existence of the species, and is not likely to destroy or adversely modify its proposed critical habitat. Johnson's seagrass is known to occur in parts of the ICW, but the exclusion of the ICW channel in the designated area will not affect NMFS' ability to review and prohibit adverse impacts to the species. The CO contains pre-dredging survey guidelines which provide that the number and severity of impacts to the species be tracked over time in conjunction with other impacts affecting the species in its range. New dredging or expansion projects will be reviewed separately under section 7.

*5. Exclusion of Other Project Types or Areas*

Some commenters requested exclusion of other project types or areas besides that of the ICW channel, including: (a) the ICW right-of-way in addition to the channel; (b) all Florida Department of Transportation right-of-way and Submerged Land Easements which encompass existing bridges; (c) current docks, canals, and areas requiring dredging and boat use; (d) public boat ramps and existing basins; (e) any access channels and public and private maintenance of existing channels and piers and docking facilities; (f) public navigation channels; (g) areas adjacent to the Town of Jupiter; (h) Sealine Marina Yachting Center basin; (i) clean-up dredging of the Miami River. One commenter recommended exclusion of: (1) a 500-ft. (152.4 m) buffer adjacent to all privately-owned uplands, (2) the ICW and its adjacent right-of-way, (3) all areas within the preempted area of State submerged land leases, easements, consents of use or other State proprietary authorizations, (4) all marina facilities in existence at the time of listing, and (5) all existing access channels.

*Response*: The ICW channel has been excluded from critical habitat since it involves ongoing maintenance of a disturbed area. The CO developed for these ICW and ports maintenance projects analyzed the impacts of these activities on Johnson's seagrass. The CO did not consider new ICW dredging or expansion projects involving deepening or widening of the right-of-way. Because of the additional adverse impacts these projects will have on the species and habitat, above those considered in the CO, these projects will be considered separately in the ESA section 7 process. With regard to other areas, the critical habitat designation may be revised in the future as data become available. Critical habitat designation should have no effect on currently existing structures such as docks, marinas, and basins in designated critical habitat unless Federal authorization is required. NMFS would review, at that time, any proposed changes to those structures or facilities. In Biscayne Bay, the Miami River, the Little River, and the Oleta River are excluded from Johnson's seagrass critical habitat beyond its mouth. Any proposed dredging projects of this river that are authorized, funded, or carried out by a Federal agency may be reviewed under the section 7 process for impacts to listed species under NMFS purview.

*6. Submerged Land Lease Holding*

One commenter, representing a private party holding the lease to submerged lands included in critical habitat designation, questioned how this party would be compensated for loss of this land.

*Response*: The land designated as critical habitat is not a taking of private property. A critical habitat designation does not impose any additional burdens on private property rights than those imposed by the species listing. A private landowner continues to be free to use his land as he sees fit, using care that his land management does not violate any ESA 4(d) regulations. The critical habitat designation simply clarifies the areas within which one's activity may impact Johnson's seagrass. The designation may affect such property if there is a Federal action that triggers the section 7 process.

*7. Biscayne Bay Comments*

There were numerous comments on the size of Biscayne Bay compared to the other areas proposed for designation in the north and central part of its range. Some commenters supported the designation. Comments opposed to the size of the designation included: (a) the

area should not be so big because it is highly industrialized, with heavy commerce and recreational boating and development; (b) the area is too large as most of it is already dredged and seawalled; (c) the size of the area is not scientifically supported and is overreaching; and (d) the designation will stall and frustrate the orderly expansion of facilities to support recreation in the Bay. Those in support of the designation believed it to be beneficial to the species where the risk of development is great. One commenter suggested a more focused approach in Biscayne Bay Aquatic Preserve.

*Response*: NMFS believes that this designation, based upon criteria for Johnson's seagrass critical habitat, is currently appropriate and necessary for the survival of Johnson's seagrass in its southern range. Based on comments received, this critical habitat area was re-evaluated by NMFS and by members of the Recovery Team.

The species, by nature, is patchily distributed. Johnson's seagrass occurs in approximately a 2-percent abundance in comparison to all species of seagrass throughout its range. In Biscayne Bay, a highly-impacted system, Johnson's seagrass is not known to occur in the same abundance or to be as widely distributed as in areas of its northern and middle range. Larger seagrasses, predominantly *Thalassia*, begin to out-compete

Johnson's seagrass in this area. Eiseman and McMillan (1980) documented Johnson's seagrass in the vicinity of Virginia Key, Key Biscayne (Lat 25 45¢); this location is considered to be the southern limit of the species range. There have been no reports of this species further south of the currently known southern distribution. The presence of Johnson's seagrass in northern Biscayne Bay (north of Virginia Key) is well documented. In addition to localized surveys, the presence of Johnson's seagrass has been documented by various field experiences and observations of the area by Federal, state and county entities. Johnson's seagrass has been documented in various COE and USCG permit applications reviewed by NMFS. The Dade County Department of Environmental Resources has mapped a general seagrass coverage of Biscayne Bay, and a wide-range, long-term monitoring program for Johnson's seagrass is recommended.

Development, man-made impacts, and human use of the submerged lands in this waterbody are heavy and there is a management need to protect critical habitat for Johnson's seagrass based on this pressure. Protection of the northern and southern ranges of the species is identified as a criteria essential to the protection of Johnson's seagrass. Genetic diversity in its southern range may be

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greater than in the north or central parts of the range and unique from either the north or central range. The unique phenotypic and genotypic characteristics of these populations could be an important reservoir for characteristics resistant to extinction and conducive to survival and growth. The State of Florida designated Biscayne Bay as an aquatic preserve, recognizing it as ''an exceptional area of submerged bay lands and natural waterways tidally connected to the bay'' (Florida Administrative Code 18–18). Concurrently, the section of Biscayne Bay Aquatic Preserve designated as critical habitat for Johnson's seagrass is considered by NMFS to be essential to the survival of the species. Final critical habitat designation may be revised as new data become available. New information, possibly through a long-term, wide-range monitoring program and increased ground-truthing of seagrass species in the Bay, could identify the distribution, abundance, and persistence of Johnson's seagrass. This new information could allow NMFS, in the future, to further refine areas in the southern end of the species' range. The species may not occur in 100 percent of the area. However, protection of Johnson's seagrass throughout this area is considered by NMFS to be essential to the conservation and survival of the species.

*8. Additional Areas Recommended For Critical Habitat Designation*

Various parties recommended the increase in the size and/or the addition of sites in the north and central parts of the range. Commenters believed that the modest acreage proposed, representing only about 7 percent of the species' range, does not fully represent the area occupied by the respective beds over time. The following areas were recommended for expansion: (a) Sebastian Inlet, (b) Fort Pierce Inlet, (c) Jupiter Inlet, (d) Jupiter Sound, (e) Lake Worth/Bingham Island, and (f) Lake Wyman.

The following new areas were recommended to be added as new critical habitat: (a) The entire area of Indian River Lagoon, from Ft. Pierce Inlet to St. Lucie Inlet; (b) Herman's Bay, St. Lucie County; (c) three sites in the Loxahatchee River/Estuary; (d) a site south of Lake Worth Inlet and Peanut Island; (e) a site at Royal Park Bridge, Palm Beach County; (f) two sites south of Boynton Inlet; and (g) site(s) in Broward County. A few commenters believed that the 10-year persistence criterion eliminates significant populations from critical habitat consideration, and that it is too strict. They recommended reduction in the time frame to 3 years to identify a persistent population of Johnson's seagrass.

*Response*: Five criteria for designating Johnson's seagrass critical habitat were developed by the members of the recovery team (See Critical Habitat for Johnson's seagrass). The size of the areas in the north and central part of the species range were based on the criteria for persistent and flowering populations and indicate the shoals of persistent beds. These areas have been studied for 10 years and have shown the ability to persist where other areas in the general vicinity have not. Johnson's seagrass is patchily distributed, has rapid growth and turnover, and migrates across the sea floor. Recruitment from fragmentation and migration are random processes which do not guarantee the persistence of the species in any one location. The areas designated in Indian River Lagoon, Hobe Sound, Jupiter Inlet, and Lake Worth Lagoon indicate populations that have persisted and flowered for 10 years despite these species characteristics. Environmental characteristics of these sites appear favorable to the species, while in other locations in the lagoon, populations have disappeared. Based upon the Recovery Team recommendations, NMFS believes that 10-year persistence is a valid criterion for designating critical habitat for Johnson's seagrass. Refinement of these areas was possible due to the information from permanent transects, genetic information, State of Florida marina siting and dock shading studies, and Palm Beach County Lake Worth Lagoon surveys.

The Lake Wyman site is a critical area for the existing genetic variability of Johnson's seagrass found in the central part of its range. With a re-examination and further interpretation from Florida Fish and Wildlife Conservation Commission's (FFWCC) marina survey and dock shading data, NMFS concurs that the proposed designation of 3.3 acres excluded the contiguous and dense beds of Johnson's seagrass southward. As a result, NMFS has expanded the southern boundary of this area approximately 1500 ft. (457.2 m) in order to more adequately protect this genetic variability in the central range, particularly from stochastic events.

Some of the recommendations to add new areas were based on reducing the criterion for persistence from 10 years to 3 years. However, NMFS believes, based on Recovery Team recommendations,

that the 10-year time period most accurately identifies persistent areas of Johnson's seagrass. The Loxahatchee Estuary, just west of the Jupiter Inlet, holds a large monotypic population of Johnson's seagrass. However, historical survey data on the persistence of Johnson's seagrass in this area do not currently exist. Future data on the ability of Johnson's seagrass to persist in this euryhaline (wide range of salinity) environment, with its extreme changes in salinity, may indicate this to be a unique site for Johnson's seagrass. NMFS may, therefore, consider this site as critical habitat in future rulemaking based on its unique environmental characteristics.

Comments were made that there should be more than two areas proposed for critical habitat designation in Lake Worth Lagoon, which is an essential area of abundance for *Halophila* species. Further analysis from FFWCC, and a re-evaluation of the data provided by Palm Beach County and State of Florida marina siting surveys and dock studies, support the addition of a critical habitat site in Lake Worth Lagoon, south of Lake Worth Inlet and Peanut Island. The population of Johnson's seagrass in this area is well-documented as an abundant, persistent (at least 10 years) and flowering population of mixed *Halophila* and monotypic Johnson's seagrass. Any additions or revisions that may be made in the future to this final rule will go through another proposed and final rule process with public input.

*9. Protection of All Seagrasses/ ecosystem*

Many individuals expressed support for the designation and voiced the need to protect all seagrasses, emphasizing the ecological benefits (such as a nursery/spawning ground) of seagrass conservation, not only for a single species, but for the ecosystem. Many commenters expressed concerns about massive releases of freshwater by the COE from Lake Okechobee and threats to the entire system from development.

*Response*: NMFS supports efforts and plans to conserve and manage ecosystems and appreciates the role that the ESA can take in protecting those species most threatened or endangered in these systems. NMFS' authority is under the ESA in protecting listed species, and NMFS believes that the ESA section 7 consultation process benefits the protection of other seagrasses and the diversity of the shallow estuarine ecosystem. NMFS appreciates the opportunity to participate in the Lake Worth Lagoon project, Indian River Lagoon Management Plan, Biscayne Bay initiative and the South Florida Ecosystem Restoration Plan.

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*10. Lack of Scientific Information*

A few commenters suggested that critical habitat was not determinable and should not be designated at this time. Reasons given included: (a) a lack of information on how the species propagates; (b) the need for further study on habitat preferences; and (c) a lack of essential information determining the physical and biological features that are essential to the conservation of a given species.

*Response*: These factors were considered in the decision to list the species. Essential information does exist for Johnson's seagrass, as provided at the time of listing. The range of the species has been delineated and there is a clear understanding of how the species grows and propagates (Kenworthy, 1999, 1997). Since its listing, further information in terms of genetic variability, patch dynamics, persistence and abundance, and transplanting capabilities has been found for Johnson's seagrass. Further studies will be valuable in answering questions about the species' patch and population dynamics, dispersion, and transplanting capabilities. However, NMFS believes that sufficient and conclusive information exists at this time for the designation of critical habitat for Johnson's seagrass.

*11. Critical Habitat is Only to be Designated Where Species Physically Occurs*

Some commenters interpreted the ESA definition of ''critical habitat'' (section 3(5)(i); ''The specific areas within the geographic area occupied by the species'') as meaning that critical habitat can only be designated where the species physically occurs.

*Response*: A species does not have to occupy 100 percent of a critical habitat area. This would be similar to drawing a ''box'' around a plant or animal but not providing it with its requirements for space, population growth, normal behavior, food, or other physiological, nutritional, and reproductive requirements (See Definition of Critical Habitat). NMFS must focus on the primary constituent elements within the designated areas that are essential to the conservation of the species and that may require special management considerations or protection, and not only the space taken up by the species. This final rule designates ''critical habitat'', as defined by the ESA, for Johnson's seagrass.

*12. Existing Regulations*

Some commenters questioned the current regulations for the protection of seagrass habitat and whether these were not enough to assure the protection of Johnson's seagrass.

*Response*: This concern was also covered at the time the species was listed. Despite existing Federal and Florida State laws aimed to conserve and protect seagrass habitat, there is a continued and well documented loss of seagrass habitat in the United States. NMFS acknowledges that many portions of the proposed critical habitat for Johnson's seagrass overlap with other special areas, such as the Indian River Lagoon and Biscayne Bay Aquatic Preserves. The critical habitat designation will underscore and strengthen the protective goals of these areas.

**Changes to the Proposed Rule**

Based on comments and new information received on the proposed rule, NMFS is modifying the proposed critical habitat designation for Johnson's seagrass as follows:

(1) Exclusion of Federal navigation channels of the ICW that occur in critical habitat areas. This includes the following areas: (a) An interior portion of the Indian River Lagoon, north of the St. Lucie Inlet; (b) Hobe Sound; (c) the site in central Lake Worth Lagoon near Bingham Island; (d) a site in Lake Worth Lagoon, Boynton Beach; (e) a site in Lake Wyman, Boca Raton; and the portion of Biscayne Bay designated as critical habitat.

(2) Extension of Lake Wyman critical habitat area by 1500 ft. (457.2 m) south from the proposed area.

(3) Exclusion of the Miami River and Little River beyond their mouths at Biscayne Bay.

Maps are provided for reference purposes to guide Federal agencies and other interested parties in locating the general boundaries of the critical habitat. They do not constitute the definition of the boundaries of critical habitat. Persons must refer to the regulations at 50 CFR 226.213 for the actual boundaries of the designated critical habitat. Figures 1 through 9 illustrate the ten areas being designated as critical habitat for Johnson's seagrass. These maps do not illustrate the exclusion of the ICW channel.

**References**

The complete citations for the references used in this document are available upon request (see **FOR FURTHER INFORMATION CONTACT**).

**Classification**

NMFS has determined that Environmental Assessments or an Environmental Impact Statement, as defined under the authority of the National Environmental Policy Act of

1969, need not be prepared for this critical habitat designation. See *Douglas County* v. *Babbitt*, 48 F.3d 1495 (9th Cir. 1995), cert. denied, 116 S.Ct. 698 (1996). NMFS is designating ten areas in the range of Johnson's seagrass as critical habitat. This designation will not impose any additional requirements or economic effects upon small entities beyond those which may accrue from section 7 of the ESA. Section 7 requires Federal agencies to ensure that any action they carry out, authorize, or fund is not likely to jeopardize the continued existence of any listed species or to result in the destruction or adverse modification of critical habitat (ESA section 7(a)(2)). The consultation requirements of section 7 are nondiscretionary and are effective at the time of species' listing. Therefore, Federal agencies must consult with NMFS to ensure that their actions do not jeopardize a listed species, regardless of whether critical habitat is designated.

In the future, should NMFS determine that designation of additional habitat areas in the species' range and/or outside the species' current range is necessary for conservation and recovery, NMFS will analyze the incremental costs of the action and assess its potential impacts on small entities, as required by the Regulatory Flexibility Act.

Accordingly, the Chief Counsel for Regulation of the Department of Commerce has certified to the Chief Counsel for Advocacy of the Small Business Administration that the critical habitat designation would not have a significant economic impact on a substantial number of small entities, as described in the Regulatory Flexibility Act.

The Assistant Administrator for Fisheries, NOAA, has determined that the designation is consistent to the maximum extent practicable with the approved Coastal Zone Management Program of the State of Florida. This determination has been submitted for review by the responsible State agency under section 307 of the Coastal Zone Management Act.

The Assistant Administrator for Fisheries, NOAA, has determined this rule is not significant for purposes of E.O. 12866.

This final rule does not contain a collection-of-information requirement for purposes of the Paperwork Reduction Act.

In accordance with E.O. 13132, NMFS has prepared the following federalism summary impact statement. When



NMFS issued a proposed rule to designate critical habitat for Johnson's seagrass in 1994, NMFS began consulting with the State of Florida. While the state expressed support for protection of Johnson's seagrass, it also expressed concern over the possible economic impacts of a critical habitat designation. NMFS understands the concerns of the state regarding timely maintenance of state and Federal navigation channels, ports, and inlets, and NMFS' goal is to protect the species with minimal effects to these activities. Concerns regarding possible economic impacts of a critical habitat designation are addressed in the preamble to this final rule. In addition, NMFS has completed a conference opinion with the COE on the effects of maintenance dredging on Johnson's seagrass and its critical habitat. NMFS expects that maintenance dredging will not be negatively impacted by this final critical habitat designation.

**List of Subjects in 50 CFR Part 226**

Endangered and threatened species.

Dated: March 30, 2000.

**Andrew A. Rosenberg,**

*Deputy Assistant Administrator for Fisheries, National Marine Fisheries Service.*

For the reasons set forth in the preamble, 50 CFR part 226 is amended as follows:

**PART 226—DESIGNATED CRITICAL HABITAT**

1. The authority citation for part 226 continues to read as follows:

**Authority:** 16 U.S.C. 1533.

2. Section 226.213 is added to part 226 to read as follows:

**§ 226.213 Critical habitat for Johnson's seagrass.**

Critical habitat is designated to include substrate and water in the following ten portions of the Indian River Lagoon and Biscayne Bay within the current range of Johnson's seagrass.

(a) A portion of the Indian River, Florida, north of Sebastian Inlet Channel, defined by the following coordinates:
Northwest corner: 27 51'15.03²N, 80 27'55.49²W
Northeast corner: 27 51'16.57²N, 80 27'53.05²W
Southwest corner: 27 51'08.85²N, 80 27'50.48²W
Southeast corner: 27 51'11.58²N, 80 27'47.35²W

(b) A portion of the Indian River, Florida, south of the Sebastian Inlet Channel, defined by the following coordinates:
Northwest corner: 27 51'01.32²N, 80 27'46.10²W
Northeast corner: 27 51'02.69²N, 80 27'45.27²W
Southwest corner: 27 50'59.08²N, 80 27'41.84²W
Southeast corner: 27 51'01.07²N, 80 27'40.50²W

(c) A portion of the Indian River Lagoon in the vicinity of the Fort Pierce Inlet. This site is located on the north side of the entrance channel just west of a small mangrove vegetated island where the main entrance channel bifurcates to the north. The area is defined by the following coordinates:
Northwest corner: 27 28'06.00²N, 80 18'48.89²W
Northeast corner: 27 28'04.43²N, 80 18'42.25²W
Southwest corner: 27 28'02.86²N, 80 18'49.06²W
Southeast corner: 27 28'01.46²N, 80 18'42.42²W

(d) A portion of the Indian River Lagoon, Florida, north of the St. Lucie Inlet, from South Nettles Island to the Florida Oceanographic Institute, defined by the following coordinates and excluding the Federally-marked navigation channel of the Intracoastal Waterway (ICW):
Northwest corner: 27 16'44.04²N, 80 14'00.00²W
Northeast corner: 27 16'44.04²N, 80 12'51.33²W
Southwest corner: 27 12'49.70²N, 80 11'46.80²W
Southeast corner: 27 12'49.70²N, 80 11'02.50²W

(e) Hobe Sound beginning at State Road 708 (27 03'49.90²N, 80 07'20.57²W) and extending south to 27 00'00.00²N, 80 05'32.54²W and excluding the federally-marked navigation channel of the ICW.

(f) Jupiter Inlet at a site located just west of the entrance to Zeek's Marina on the south side of Jupiter Inlet and defined by the following coordinates (note a south central point was included to better define the shape of the southern boundary):
Northwest corner: 26 56'43.34²N, 80 04'47.84²W
Northeast corner: 26 56'40.93²N, 80 04'42.61²W
Southwest corner: 26 56'40.73²N, 80 04'48.65²W
South central point: 26 56'38.11²N, 80 04'45.83²W
Southeast corner: 26 56'38.31²N, 80 04'42.41²W

(g) A portion of Lake Worth, Florida, just north of Bingham Island defined by the following coordinates and excluding the Federally-marked navigation channel of the ICW:
Northwest corner: 26 40'44.00²N, 80 02'39.00²W
Northeast corner: 26 40'40.00²N, 80 02'34.00²W
Southwest corner: 26 40'32.00²N, 80 02'44.00²W

Southeast corner: 26 40'33.00²N, 80 02'35.00²W
(h) A portion of Lake Worth Lagoon, Florida, located just north of the Boynton Inlet, on the west side of the ICW, defined by the following coordinates and excluding the Federally-marked navigation channel of the ICW:
Northwest corner: 26 33'28.00²N, 80 02'54.00²W
Northeast corner: 26 33'30.00²N, 80 03'04.00²W
Southwest corner: 26 32'50.00²N, 80 03'11.00²W
Southeast corner: 26 32'50.00²N, 80 02'58.00²W
(i) A portion of northeast Lake Wyman, Boca Raton, Florida, defined by the following coordinates and excluding the Federally-marked navigation channel of the ICW:
Northwest corner: 26 22'27.00²N, 80 04'23.00²W
Northeast corner: 26 22'27.00²N, 80 04'18.00²W
Southwest corner: 26 22'05.00²N, 80 04'16.00²W
Southeast corner: 26 22'05.00²N, 80 04'18.00²W
(j) A portion of Northern Biscayne Bay, Florida, defined by the following: The northern boundary of Biscayne Bay Aquatic Preserve, NE 163rd Street, and including all parts of the Biscayne Bay Aquatics Preserve as defined in 18-18.002 of the Florida Administrative Code (F.A.C.) excluding the Oleta River, Miami River and Little River beyond their mouths, the federally-marked navigation channel of the ICW, and all

existing federally authorized navigation channels, basins, and berths at the Port of Miami to the currently documented southernmost range of Johnson's seagrass, Central Key Biscayne (25 45'N).

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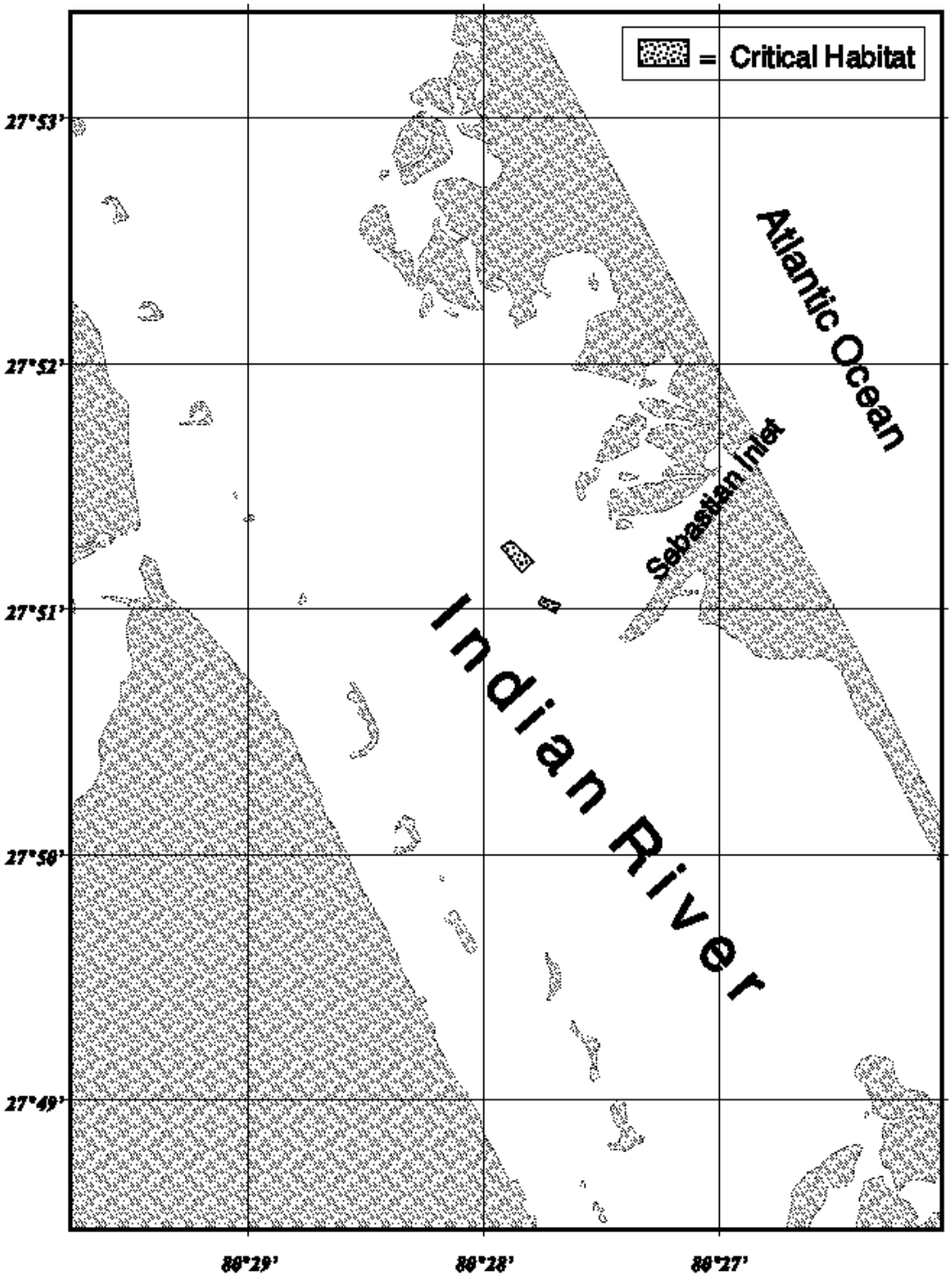
Figure 1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27°53'
27°52'
27°51'
27°50'
27°49'
80°29'
80°28'
80°27'
Atlantic Ocean
Sebastian Inlet
Indian River

Figure 2

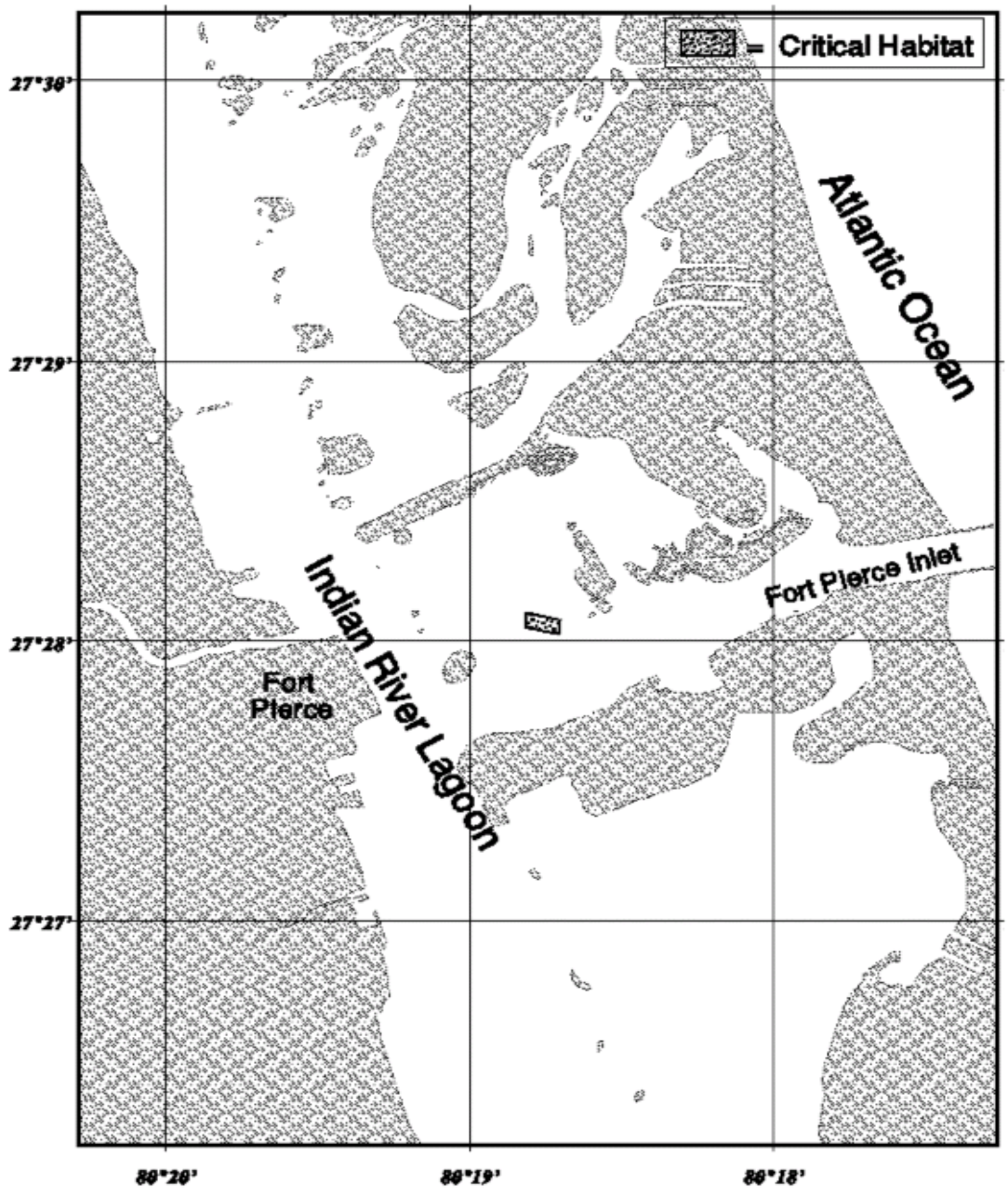

= Critical Habitat
27°30'
27°29'
27°28'
27°27'
80°20'
80°19'
80°18'
Atlantic Ocean
Fort Pierce Inlet
Indian River Lagoon
Fort Pierce

Figure 3

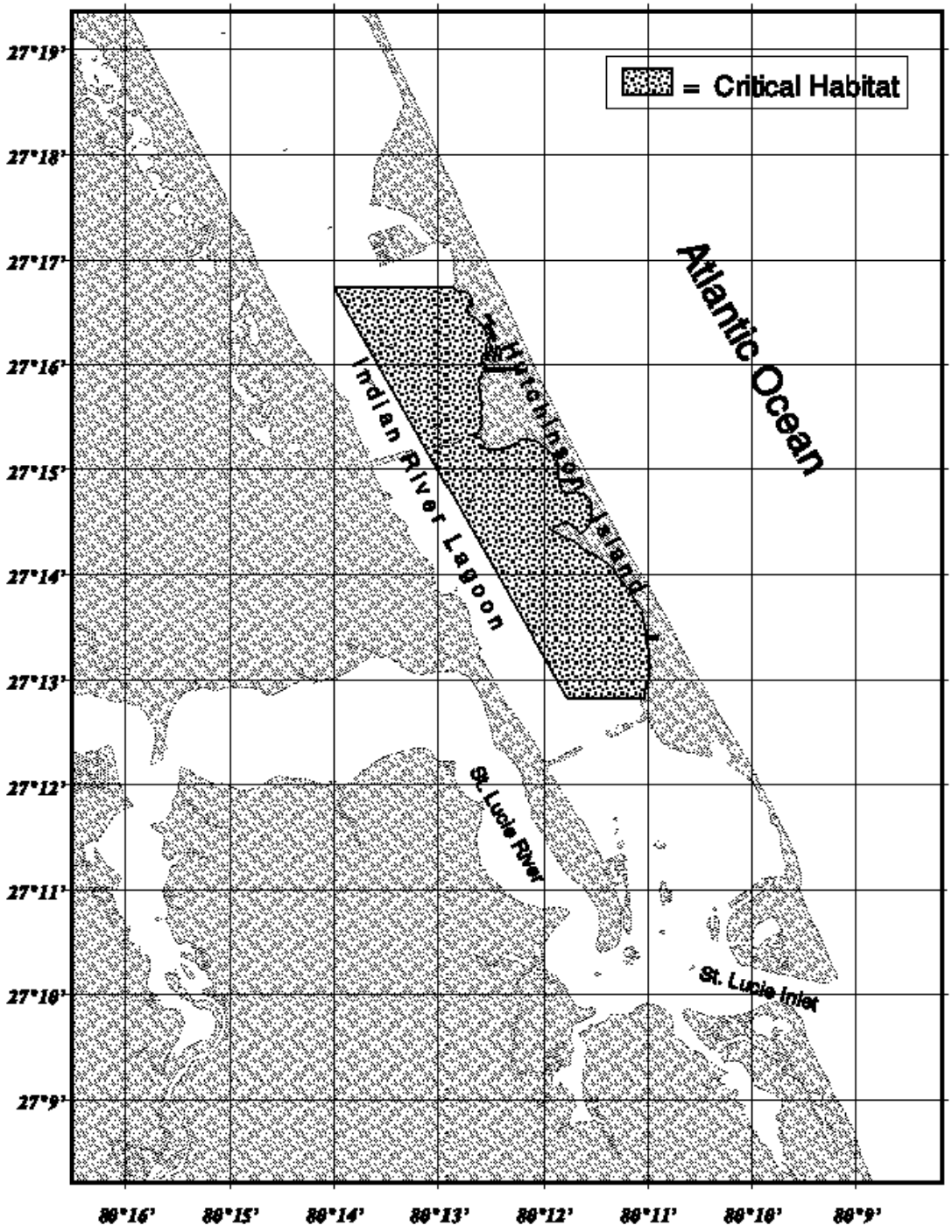
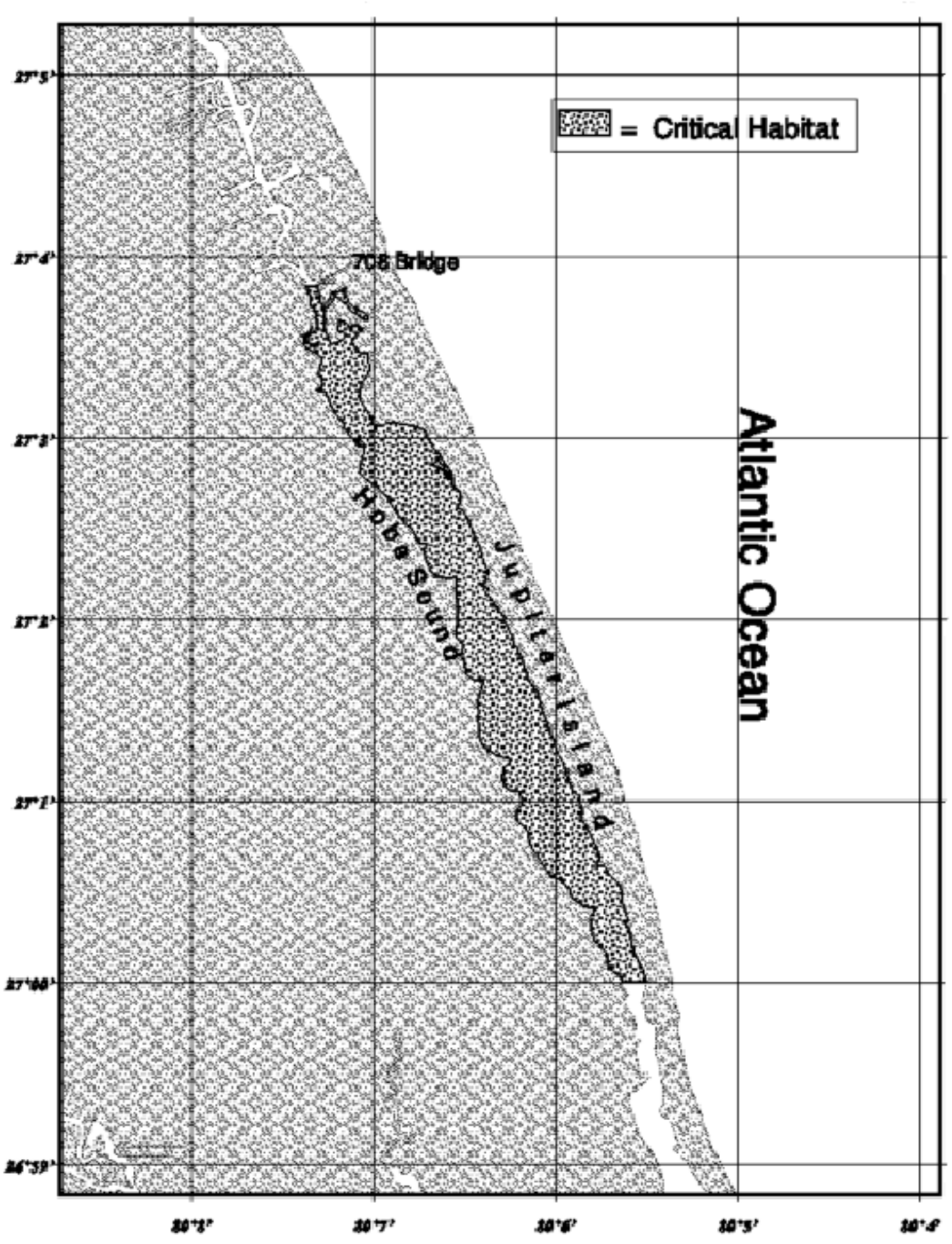

= Critical Habitat
Atlantic Ocean
Hutchinson Island
Indian River Lagoon
St. Lucie River
St. Lucie Inlet
27°19'
27°18'
27°17'
27°16'
27°15'
27°14'
27°13'
27°12'
27°11'
27°10'
27°9'
80°16'
80°15'
80°14'
80°13'
80°12'
80°11'
80°10'
80°9'

Figure 4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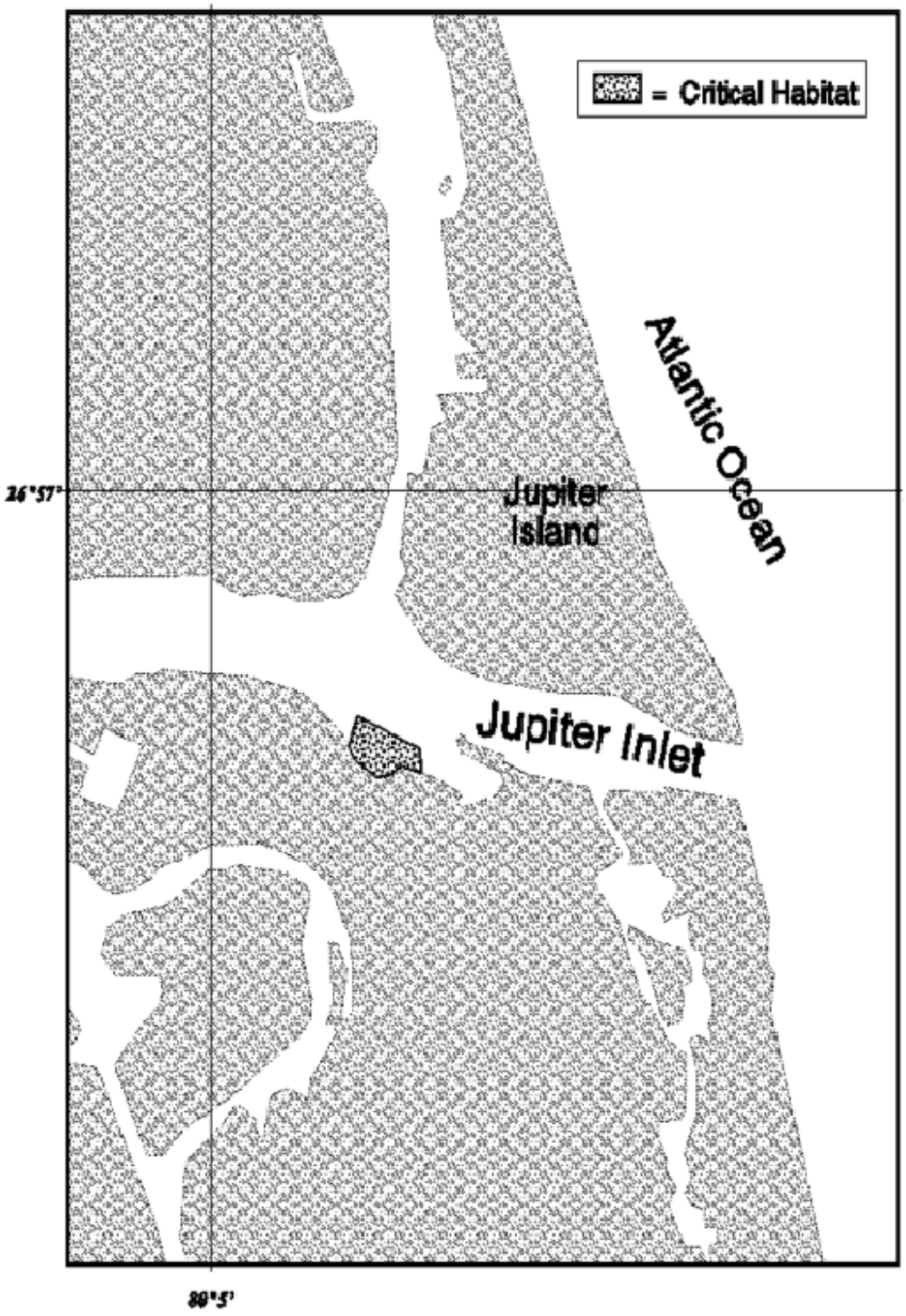
Atlantic Ocean
Hobe Sound
Jupiter Island

Figure 5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Atlantic Ocean
Jupiter Island
Jupiter Inlet
26°57'
80°5'

Figure 6

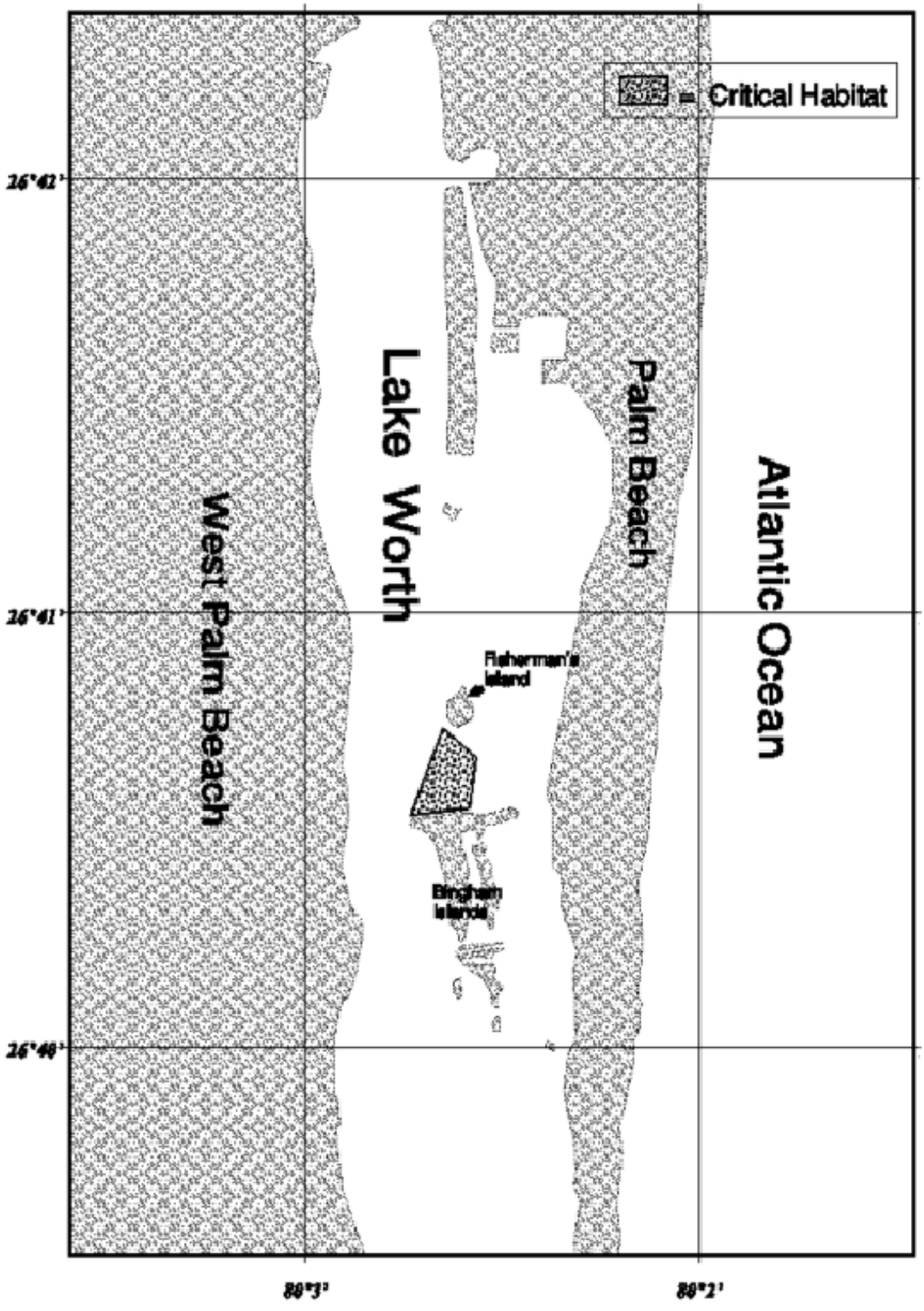
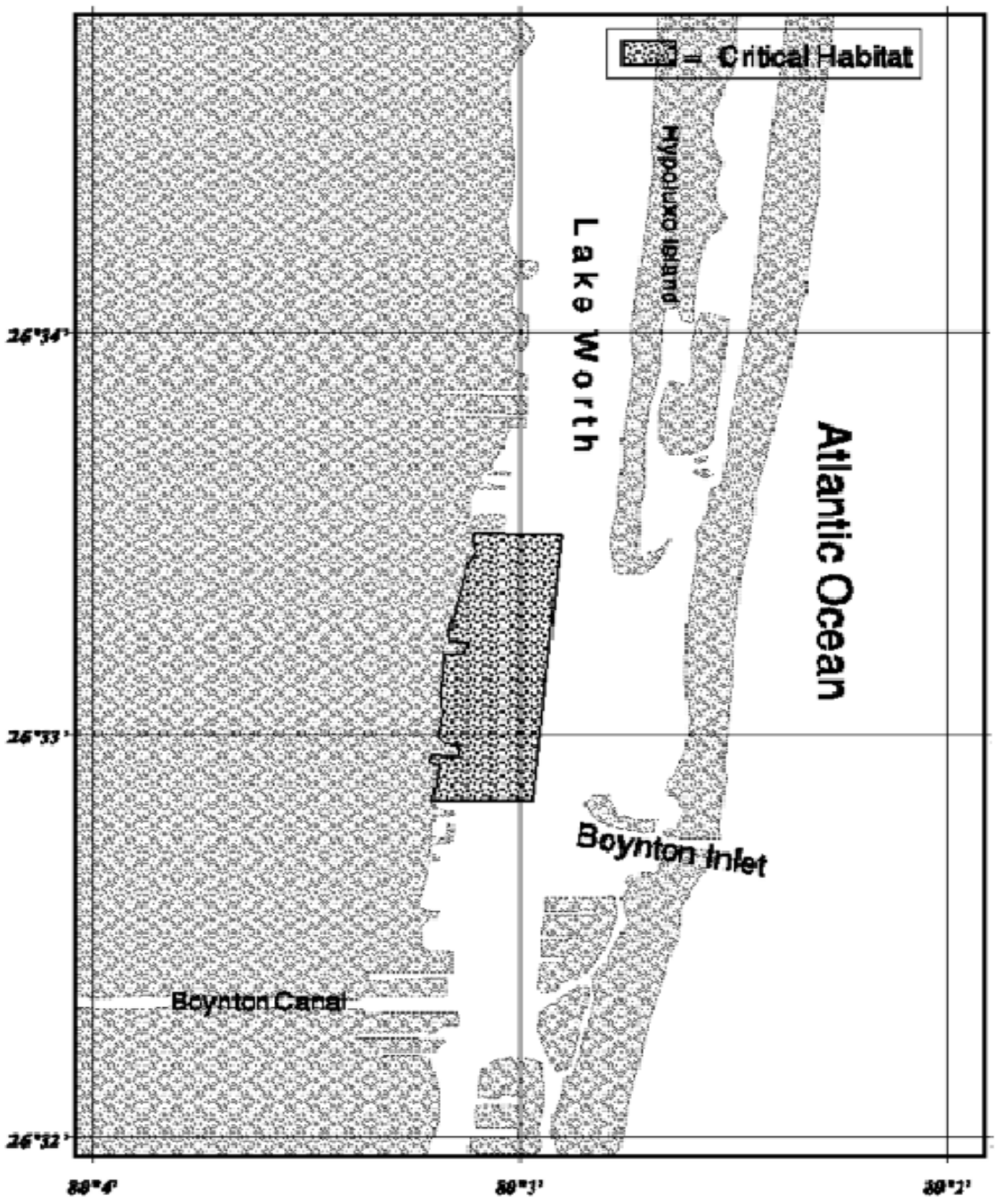

= Critical Habitat
26°42'
26°41'
26°40'
80°3'
80°2'
Lake Worth
West Palm Beach
Palm Beach
Atlantic Ocean
Fisherman's Island
Bingham Islands

Figure 7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Hypoluxo Island
Lake Worth
Atlantic Ocean
Boynton Inlet
Boynton Canal
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26°33'
26°32'
80°4'
80°3'
80°2'

Figure 8

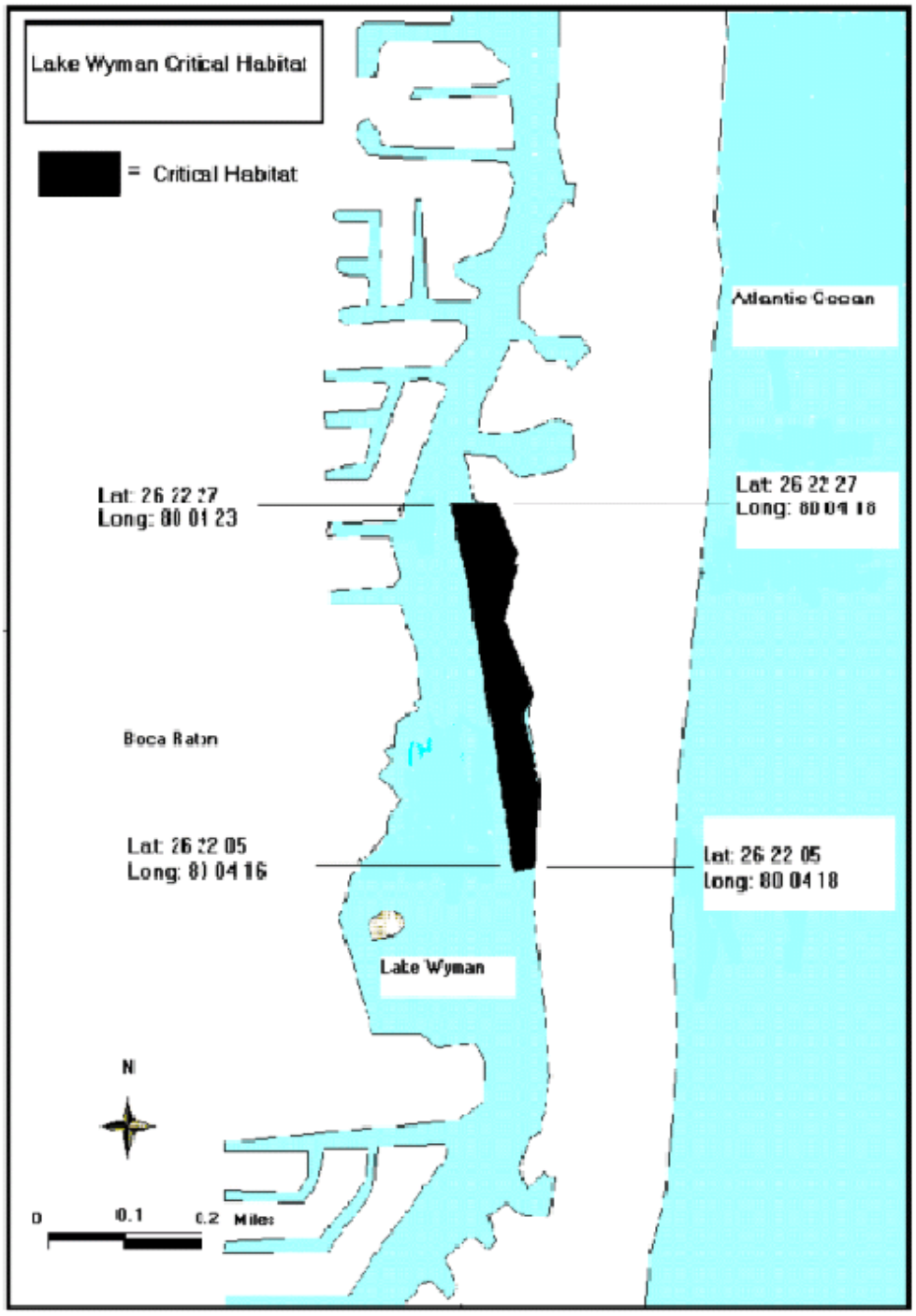
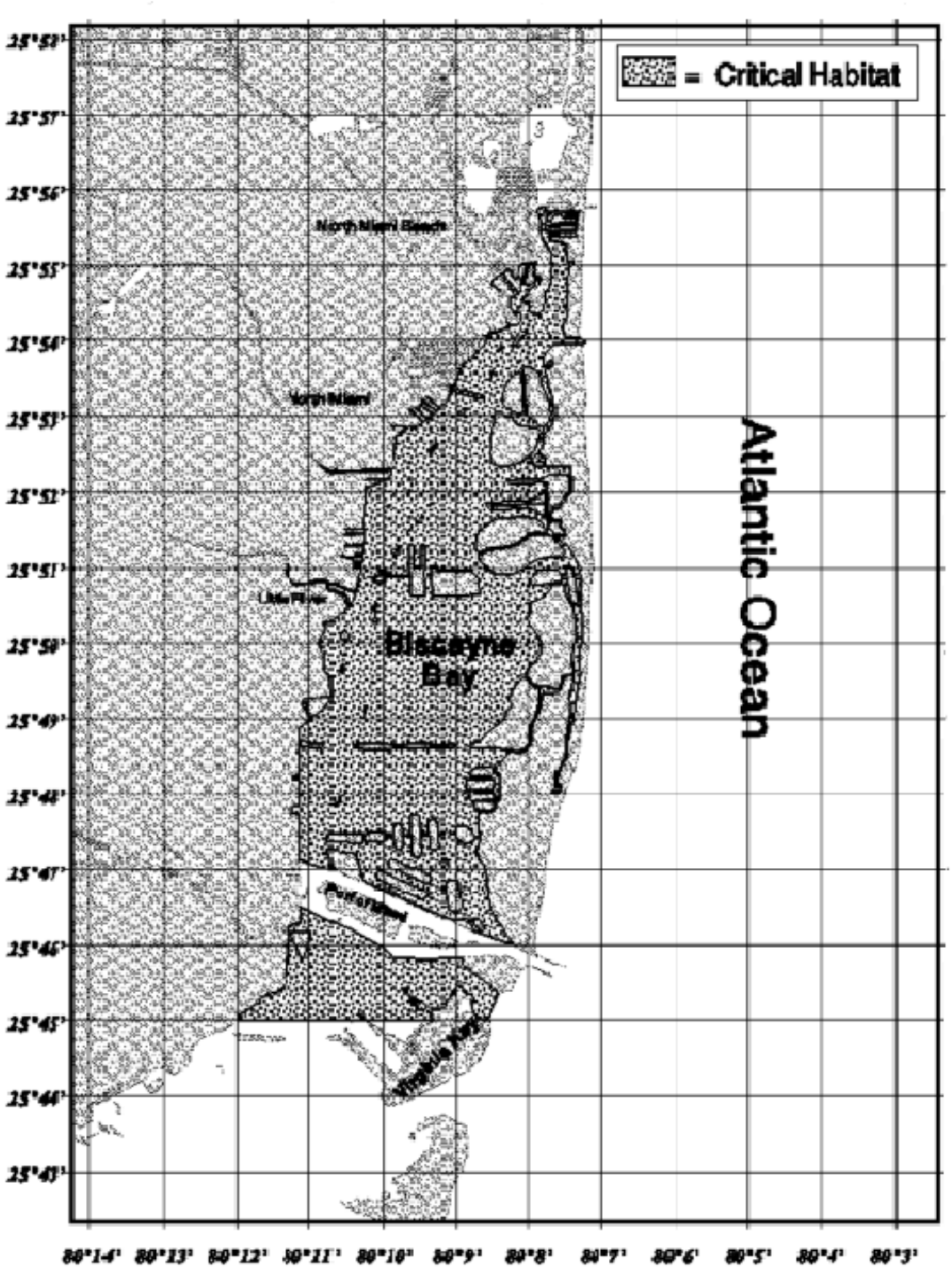

Lake Wyman Critical Habitat
= Critical Habitat
Atlantic Ocean
Lat: 26 22 27
Long: 80 01 23
Lat: 26 22 27
Long: 80 04 18
Boca Raton
Lat: 26 22 05
Long: 80 04 16
Lat: 26 22 05
Long: 80 04 18
Lake Wyman
N
0
0.1
0.2 Miles

Figure 9


= Critical Habitat
Atlantic Ocean
Biscayne Bay
25°58'
25°57'
25°56'
25°55'
25°54'
25°53'
25°52'
25°51'
25°50'
25°49'
25°48'
25°47'
25°46'
25°45'
25°44'
25°43'
80°14'
80°13'
80°12'
80°11'
80°10'
80°9'
80°8'
80°7'
80°6'
80°5'
80°4'
80°3'

## APPENDIX III

**Recommendations for sampling *Halophila johnsonii* at a project site**

**Recommendations for sampling *Halophila johnsonii* at a project site**

The above-suggested approaches for sampling *H. johnsonii* are recommendations of the *H. johnsonii* Recovery Team.

**OBJECTIVE:**

To outline recommended survey methods for determining the distribution and abundance of *H. johnsonii* at sites under permit review. The methods should be applicable to a broad range of project scales, from a 20-m long dock, to marinas, bridges, and channels several kilometers long.

**PROBLEM:**

Three aspects make quantitative sampling for *H. johnsonii* difficult: (1) Poor visibility; it is sometimes difficult to see more than 0.1 or even 0.01 $m^2$ at a time. (2) Patchy and clumped distribution, with patches as small as 0.01 $m^2$, which may be clumped together within a sub-area of the project area. (3) Stratified distribution, with occurrence perhaps limited to a particular depth gradient within a project area.

**RECOMMENDED METHODS:**

The most appropriate approach depends on scale, and the amount of expected error depends on the approach. Unless a complete survey of the entire area is done, the estimated distribution and abundance of this species may be significantly in error. With

the exception of very small project areas, efficient field sampling may require sampling in two stages. A preliminary visual reconnaissance of the site should be conducted to locate any occurrences of *H. johnsonii*. "The importance of preliminary sampling is probably the most under emphasized principal related to field studies. There is no substitute for it." (Green 1979). Following the preliminary reconnaissance, a more comprehensive sampling, using one of the techniques outlined below, should be initiated.

In situ monitoring for *H. johnsonii* is absolutely necessary. Aerial photography may be used to map distributions of larger canopy-forming species; however, mapping of *H. johnsonii* cannot be done reliably from aerial photos. Because of significant seasonal and annual variation in distribution and abundance of *H. johnsonii*, surveys must be conducted during spring/summer (April-August) period of maximum abundance, and sampling in more than one summer is recommended. Length of time between survey date and actual start of project should consider the potentially rapid turnover and migration of *H. johnsonii*. Personnel conducting the survey should clearly demonstrate that they can distinguish between *H. johnsonii* and *H. decipiens*. Surveys labeled simply as *"Halophila"* are not sufficient.

Deliverables: 1) amount (acres or square meters) impacted, 2) estimate of percent coverage and the species present/absent, 3) site map with seagrass patch or bed locations, 4) size of the patches, and 5) shoot density estimate.

SMALL PROJECT SITES (<0.1 ha, e.g. 10 m by 100 m, such as single-family docks). Two methods.

1. Provide a site map of submerged lands adjacent to the action area. The site map should include transects approximately every 7.5 m apart, perpendicular to the shore, and for a length 6 m longer than the proposed activity. A preliminary visual reconnaissance is necessary to fill in the information between the transects. Seagrass patches should be identified by species composition and drawn on the site map. Density can be accomplished with random sub-sampling for density within the identified patches. (An overall site map is important since it identifies seagrass habitat, not just existing seagrass patches.) (Mezich 2000).

2. The site is sub-divided into $m^2$ grids. A complete and intensive mapping of the entire area of concern can be developed by using DGPS, with coordinates provided every $m^2$, or every patch >0.01-0.1 $m^2$, with a tested map accuracy of >50-95%. If percent cover is not used, an illustrated, standardized scale of density should be used. Presence-absence should be determined for every $m^2$ grid cell.

For monitoring project effects, additional information on shoot density, blade length, and flowering, can be collected from a random sub-sample of grids using 25- by 25-cm quadrats or multiple 10- by 10-cm sub-cells within the $m^2$ grid.

INTERMEDIATE-AREA PROJECT SITES (0.1 to 1 ha, e.g., a 100-m by 100-m marina). A two-step process is required.

a. Preliminary visual reconnaissance to locate general *H. johnsonii* areas and distribution.

b. The site should then be surveyed using transects across the dominant spatial gradient (e.g., depth, inshore-offshore, channel-shoal, etc.) of the site. The number of transects and sample intervals should adequately describe distribution and abundance of *H. johnsonii* patches. Besides noting presence-absence, x-y-z diameters of encountered patches should be noted, together with sub-samples of shoot density, blade length, and presence of flowering.

LARGE-AREA PROJECT SITES (>1 ha). Three choices are possible after preliminary visual reconnaissance.

1. Random sampling of points or quadrats within the area.

Sampling at least 1-30% of the total area.

- 2 stages: (1) visual reconnaissance, then stratify, (2) second intensive sampling, with intensity relative to abundance of *H. johnsonii* within the strata.
- singe step of 100 -1,000 points/quadrats (min. # = ?).

2. Intensive survey of transects.

Transects across the entire area, sampling at least 1-30% of the total area.

- point-intersects sampling along transects (with the size of a "point" defined, e.g., 5 x 5 or 10 x10 cm).

- belt transect, of 0.1-2 m width.
- transects randomly located (min. # transects = 10-50 or min. spacing = 50 m).
- regularly-spaced transects (min. # transects = 10-50 or min. spacing = 50 m).
- quadrats at regular intervals along line (min. # = 10-50 or min. spacing = 50 m).

For any of these transect methods, x-y-z diameters of any patches encountered should be measured. At a minimum, presence-absence should be recorded at each point of each quadrat.

3. Combinations of above methods, e.g.,

(a) Intensive mapping in area of primary impact (e.g., within footprint of proposed dock), plus random points in surrounding, potentially affected area.

(b) Stratify from random point sampling, then map intensively in areas of greatest abundance.

It is the position of the Recovery Team, however, that the adoption of a valid survey protocol for identifying Johnson's seagrass be required by permitting agencies in the range of the species. In all seagrass surveys, emphasis should be placed on the identification of seagrass habitat as well as the distribution of currently existing patches. Identifying impacts to seagrass habitat, particularly from large projects, is more important in the long run than the "point-in-time" management approach of avoiding currently existing patches.

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